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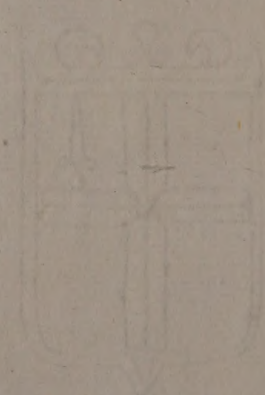
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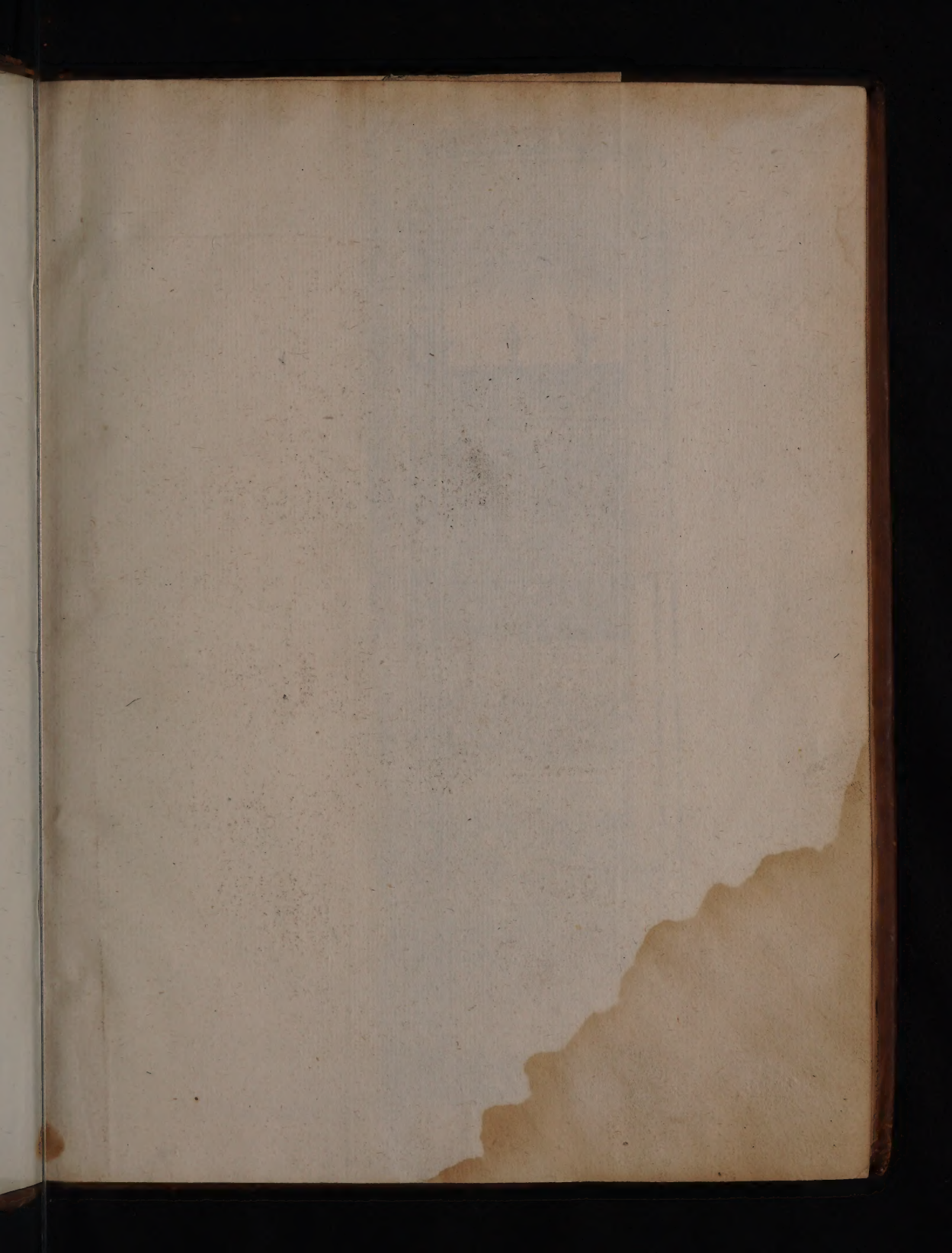
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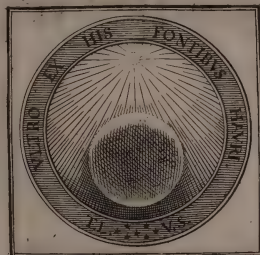




FRUIT-WALLS IMPROVED,

By Inclining them
TO THE HORIZON:
OR, A WAY
TO BUILD WALLS FOR FRUIT-TREES;
Whereby they may receive more Sun Shine,
and Heat, than ordinary.

By a Member of the Royal Society.



L O N D O N :

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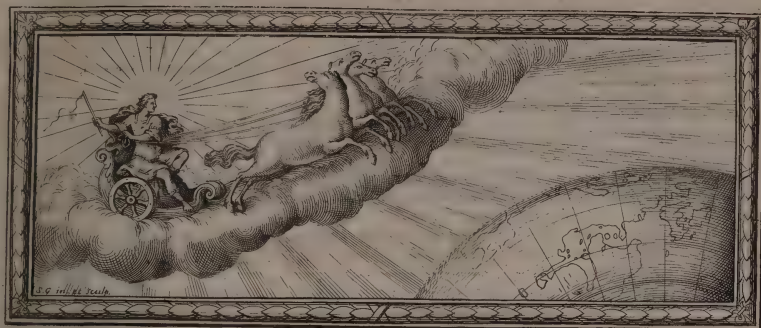
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Liber cui Titulus, *Fruit-
Walls Improved, by inclining
them to the Horizon.*

John Hoskyns, V. P. R. S.

August 31.
1698.

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TO THE
RIGHT HONOURABLE
THE
MARQUISS OF TAVISTOCK,



Y LORD,

WHILE Your Lordship
fits Your Self, in
Your Travels, to follow the
a Foot-

Footsteps of so many glorious Ancestors, I prepare for You, in the Culture of Fruits, a Diversion to those great Occupations, which Your Birth will hereafter bring upon Your Lordship. I was walking with Your Lordship, when I first thought of this Way, to make our Gardens yield better Fruits. Besides, My Lord, I cannot forget what other Titles you have, to look upon this as a domestic Production.

I shall think my self happy, if I can add something to the Innocent Pleasures of many Nations ; especially this ; for which, as well as most of the Neighbouring Countries, what I have to propose seems to be of most Use.

However, My Lord, I shall be satisfied, if, by thus endeavouring to become useful to Your Lordship, I express my most sincere Gratitude, for all the Obligations

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gations I have to Your Illustrious Family.

I am with all manner of Respect,

My LORD,

Your Lordship's

Most humble, most obedient,

and most obliged Servant,

N. F. D.

The PREFACE.

THE Reader may, perhaps, think it strange to find, in this Discourse, a mixture of Gardening and Geometry; these having had hitherto but little communication with each other. But such is the wonderful extent of Mathematicks, that very few Arts can be named, but what may be, by a due Application of them, in a great measure improved. At least I hope Experience will make this plain, in the very case we have under consideration. I

I might have published only that part of this Discourse, which could be understood by every body; or else have placed the Mathematical part, wholly by it self. But it was hard to separate them, without an injury to both. And I thought it better, that whoever does not care, for what relates to Geometry, should be desired, from hence, to read only what the Table, or Margin, will shew him to be most for his use.

And, lest the nicest Reader should have yet any occasion to complain, and think it too great a trouble, for him to chuse what he

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he may read, and what he may pass over, I have all along set, in the Margin, some Commas, over against such places, as any one, not skilled in the Mathematicks, may freely avoid. I must however except the two or three first Sheets, which were already Printed, before I thought of this Distinction. The remaining Discourse, tho some few Words in it may not be understood, by such as are unacquainted with the common Terms of ordinary Arts, will, I hope, neither prove tedious, nor offensive, to any Lovers, of Gardening; even Ladies themselves not excepted. Where I have

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have used a double row of Commas, I desire to have no other Readers, but such as have studyed, to a great degree, either Natural Philosophy, or Mathematicks, or both.

It was requisite that this Theory should not appear, without its Demonstration; that so the Curious might know the Ground, it is built upon; and satisfie the rest of the World, that here is no design laid, to impose upon them; but, on the contrary, such hopes offered, of an extraordinary Success, in raising good and early Fruits, unless the Seasons be too much wanting, as amount
al-

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almost to an intire certainty. Neither could the Directions, that were to be given, be fitly expressed, without borrowing from Geometry, and some other Mathematical Sciences, their proper Language.

I have endeavoured to be as short, as I possibly could: and there are some places, where, if one reads fast, he will hardly conceive the whole extent of the Discourse. Such are, for instance, the places, where I speak of Remedies against Winds. That very brevity, for which discerning Men are used to express so great an Esteem, will make a second
b *read.*

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reading pleasanter, less troublesome, and more profitable, whenever it will be necessary: and will help to find easily, and within a little compass, the Directions useful to Practice.

As to the Style, I am sorry to find so very few Words, and not one Sentence, to have been altered, by such, as were at the trouble to peruse my Manuscript. But the Example of the Illustrious Monsieur Hugen, who published in French his Theories of Light and Gravity, tho he was no perfect Master of that Language, makes me hope that any faults, in the Style, will be forgiven

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given me, especially by English Men; who, of all Nations, have least to reproach me withal, that I should offer to write this Treatise in English. If it be well received, perhaps a second Edition may be more accurately penned.

Most Countries may reap some Advantage, by the Theory, which I shall propose: but especially such, as have more than 45 Degrees Latitude. This comprehends, in our Europe, all England, Scotland, and Ireland; most part of France; Holland, Flanders, Germany, Switzerland; the North part of Italy; Hun-

Hungary, Sclavonia, Transilvania, Moldavia &c ; Poland, Denmark, Sweden, Muscovy ; and several other Countries of less note : but with some difference. Of these Countries, such, as lie more to the South, may expect to have, with our Walls, some excellent Figs, and Grapes, &c. with some of the Fruits of hotter Climates. But as one goes more Northwards, tho here and there some new Sorts of Fruits be met withal, yet fewer and fewer good Fruits will, by degrees, be left, especially of those Kinds that require a great deal of Heat ; till at last most Fruits, by
the

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the help of Sloping Walls, will only shew better their Shape and Bigness, and perhaps something of their Flavour, without ever coming to a perfect maturity. For I do not doubt but that, even in those unhappy Climates, the natural Productions, which they have, will be much mended, by our Inclining Walls. Southwards of 45 Degrees Latitude, I can no more reckon, in the North Hemisphere, whole Countries, as concerned in this Discourse; but only some particular places, upon Hills and Mountains; or else some peculiar sorts of Fruits; of which some may be made forwarder,
C with-

without any prejudice from the Increase of Heat; and others may be transported, from hotter Countries: Or lastly, some peculiar Expositions; which being yet too cold, as, for instance, the North Expositions, may be helped, as much, as one pleases, by duly inclining their Walls.

*As our Theory is not restrained to Europe, nor to Countries on this side the Equinoctial Line; so it is not proper only to Men of great Estates: but whoever is able to have a Wall, about his Garden, may, in some proportion, enjoy the Advantage, that arises from it. 'Tis true I have principally considered
how*

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how large Gardens, for Fruit, might be made useful, handsome, and stately. And this being the hardest part, and including all the Directions, necessary to those, that can be but at a small Expence, what I had more to say, in reference to them, was the less considerable. No body therefore ought to complain, that I forgot his Case.

It is not just that we should lay open those rich Presents, which the Author of Nature offers us, without expressing a due Sense of His Magnificence and Greatness. Who can avoid admiring that Supream and Infinite Wisdom,

c 2 which

which makes every where such an immense variety, of most graceful and excellent Productions, to cover the whole Face of the Earth, and to spring out of the very Ground? From thence it is that, notwithstanding their different Proprieties, they all draw wonderfully their Life, and the Spirit that animates them; to the Amazement of any, that considers this surprising Operation.

Fruit-

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 p. 127. l. 8. fear yet left. p. 128. l. 4. Frontispice.

ADVERTISEMENT.

A Mistake of one Degree, in the supposed Latitude of *Paris*, which ought to have been 48 Degrees 50 Minutes, has spread thro' the Numbers in the whole 85th Page, and the beginning of the next. But it is easie to rectifie this mistake, which is not very material. If you are minded to correct it;

Instead of 49. 183. 781. 427. 548. 427. 121. 548. 121. 487. $4\frac{1}{2}$. 2 Degrees. 49.
Write 48. 169. 773. 460. 595. 460. 135. 595. 135. 527. $5\frac{1}{4}$. 1 Degree. 48.

IN the Latin Mathematical Treatise, which will be bound at the end of some Copies of the present Discourse, the last Number in the 21th Page, ought to be 21302584.

To the BOOK-BINDER.

THE Frontispice and the Title Half-sheets ought to be folded so, one within another, as to have first two white Leafs; then the Frontispice and the Title facing each other. The Garden in Perspective ought to face the first Page; and the large Mathematical Cut ought to face the last Page, that is the 128th Page. Both these Cuts must be so disposed, as to lie, when unfolded, altogether out of the Book. After the same way must also be folded the small Mathematical Cut. It belongs to the Latin Mathematical Treatise, and it must face the 24th Page, which is the last Page of the said Treatise.

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*Horti Fructuum Edilium feracis Orthographica Delineatio, Spectatore versus Occidentem Aequinoctialem prospiciente.
 Haec Tabula Murorum ad Horizontem inclinatorum, Arboribus pandendis ac plenius diutiusque soli exponendis, exhibetur usus.*

S. Gribelin sculp.



FRUIT-WALLS IMPROVED,

BY INCLINING THEM TO THE HORIZON:

OR A WAY

TO BUILD WALLS FOR FRUIT-TREES,

Whereby they may receive more Sun-shine and Heat than ordinary.



FTER all the Application of so many Men in all Times and Countries to Agriculture, one would scarce have thought there was yet left so notable and so very obvious an Improvement

of it as that I am a going to propose. It consists in building Walls for Fruits, Grapes &c, *Idea of sloping Walls for Fruit.* not in a perpendicular Situation, as is commonly done, but so sloping, thô otherwise straight and plane, as to receive the Beams of the Sun,

A

not

not only for a longer time, but also with a much fuller and better Exposition.

It will appear that this way of building Fruit-Walls will be very advantagious, if we compare perpendicular Walls in several Countries and Expositions with one another, and with sloping Walls : examining withal some of their most considerable Proprieties.

*Defects of
perpendicular
South-walls.*

South-Walls are commonly reckoned to be the best for Fruits. But in these Climates, and much more in hotter Countries, when the Days are something long, and the Heat of the Summer is in its greatest strength, it is late before the Sun shines upon them, and the Sun leaves them as early in the Afternoon. When it is about Mid-day the Sun is so high, that it shines but faintly and very sloping upon them; which makes the Heat to be much the less; both because a small quantity of Rays falls then upon these Walls; and because that very quantity acts with a kind of glancing, and not with full force. Before or after Noon the Rays come yet upon our ordinary South-walls with more obliquity.

*Perpendicu-
lar South-
walls, East-
walls, and
West-walls
compared to-
gether.*

In the North part of France East Walls are looked upon as almost of the same goodness for Fruit as South-walls: which proceeds more from the Defect I have noted in South-walls, than from any particular Excellency in those facing the East. And accordingly South-walls are here, and in all other

other cold Climates, much the best of the two. West-walls in *France*, as well as here, are but indifferent, tho' they have the like Exposition to the Sun as East-walls. I take the reason of this difference between East-walls and West-walls to be partly because in the Morning the Air is purer, and that the Sun shines oftener and stronger than in the Afternoon; and meets with the Dew while it is yet fresh upon Plants, whose motion it revives after a long rest, and as it were a refreshing Sleep. But the chief cause of it must be attributed to the coldness of the Air in the Morning, that checks the Vegetation, till the presence of the Sun revives it; which it dos much sooner and much more effectually on the East-wall than on the Westerly. In the Afternoon the Heat of the Air is great every where; and Heat alone, without any Sun-shine, is able to make Plants vegetate, tho' not so perfectly. Which, if it were not sufficiently known, might be easily evinced from what is observed in Summer in the Fields, when the Sun happens not to be seen for some Weeks together. I said that the Sun shines stronger in the Morning than in the Afternoon, tho' it be hotter in the Afternoon than in the Morning. But this is not because the Sun in the Afternoon shines with more force; but because it continues to act upon an Air already warmed with the impression of the Morning

Sun. In order to be satisfied in it, one may, when the Days are long, compare nicely the Effects of a burning Speculum at 5, 6 and 7 a Clock in the Morning, with its Effects at 7, 6 and 5 in the Afternoon. For the like reason it is much warmer a Month or two after than a Month or two before the Summer Solstice; tho we cannot but suppose the Sun to shine sensibly with the same force at equal distances from the Tropick.

Perpendicular Walls compared with Sloping Walls.

Conceive a perpendicular Wall with Trees against it. It is evident that it is exposed only to one half of the visible Sky. And the point to which it is directly exposed falls upon the Horizon. To which point should we suppose the Sun to be something near, one half of the time it would be under the Horizon, and the other half it would shine but weakly thro so great a depth of Air.

But if we suppose the said Wall remaining on the same place to be inclined, with the Trees against it, so as to become elevated only 45 Degrees upon the Horizon, and to have the Trees on its upper side; the Wall in that situation will be exposed to three quarters of the visible Sky: and the point to which it is directly exposed will be 45 Degrees high. To all the Neighbourhood of which place if the Sun happens to come, it must needs act from thence upon the Wall with a considerable

siderable force. And so far the advantage of sloping Walls is already plain and obvious, without any Calculation.

Now if we proceed farther, and bring the matter to a Calculation, according to some Principles, which shall be explained in a proper place, and which most Mathematicians will admit of; we shall not only say that there is a great advantage in sloping Walls; but we may also shew in Numbers, sometimes exactly, sometimes by a near Computation, the Increase of Heat we shall have, by using them rather than perpendicular Walls.

Thus, for Instance, if in the Latitude of $52\frac{1}{2}$ Degrees, which is more Northerly by one Degree than London, a South-wall, very smooth and even, be so leaning as to have its Plane passing thro' the Pole of the World; which sloping for many Fruits is not altogether the best that might be assigned; the Action of the Sun upon it in an Equinoctial Day will be to the Action of the Sun in the same Day upon an ordinary upright South-wall (supposing it also to be smooth and even) as 100 to 63. And these Numbers we can easily continue with exactness to many more places at pleasure. So then here the Heat of the Sun is increased something more than in the proportion of 3 to 2 (not to say of 11 to 7) above what it is in the perpendicular Wall; which is very

The same done in a particular Example for the Equinox;

con-

considerable. But that Increase will be yet greater and greater, as the Sun comes to have a greater Northerly Declination.

*and for the
Summer Sol-
stice.*

For in the Summer Solstice the Action of the Sun, upon that even and smooth sloping Wall, will be increased so as to be upon one account more than $3\frac{1}{2}$ times greater than the Action upon the perpendicular Wall. Besides another very considerable addition of Heat, which would make that Action from $3\frac{1}{2}$ to become $4\frac{1}{2}$ times greater, were it not that something is to be subtracted from this last number, upon the account of the Light of the Sun not coming so freely thro' a greater depth of Air: which Correction has no place in the Equinoctial Day. However we may suppose the Heat, in the Summer Solstice, to be about fourfold what it would have been upon the perpendicular Wall.

*The result of
which shews
the great ad-
vantage of
Sloping
Walls.*

This Increase of Heat is so extraordinary, and for above two Months the Sun keeps so very near the Tropick, viz. within a distance from it of $3\frac{1}{2}$ Degrees, that seeing what our South-walls are already able to do, I do not doubt but such a Wall as this would make Grapes, and Figs, and other Fruits equal here in goodness to those of some much hotter Climates.

*What Coun-
tries they are
best for.*

Yet I confess this improvement for Fruit-Walls is not like to be so useful here as in France, or those other Countries where they enjoy the sight of the

IMPROVED.

the Sun oftener than we use to do ; a due regard being had every where to the natural productions of the place. Nor do I look for any excellent effect from it, unless the Trees or Grapes be raised from the best Kinds, and the Soil be good and deep, and the Trees and Vines be governed and cultivated by a skilful Artift. It is too common here to leave these Plants to themselves, and in a manner without any Culture. Whereas, besides the necessary care of Pruning them duly, they do not think it too much, even in Latitudes where they have not the same occasion for those foreign helps, to dig very frequently about them, or to do it at least four or five times in a Year.

Lest those that desire good Fruits, and are no proper Judges in an Inquiry that depends so much on Geometry, should look upon what I have said as a bare Speculation, I will make them acquainted with the following Story. By which it will appear, that as we have already our Reflexions and Calculations of our side, so we are not altogether destitute of Experience.

Having explained to a Person of Quality the present Invention of Sloping Walls, I received for answer, that upon a Sloping Wall, which I saw since, and I will describe by and by, there grew some Years ago Grapes equal in Goodness to those that grow in *France*. This Wall was nothing but a facing of Bricks laid flat (and by

A good Culture is necessary for them to have their full effect.

An Instance from Experience of the usefulness of Sloping Walls.

con-

consequence only two or three Inches thick) upon a natural slope of Earth, about seven or eight Foot high. It was of very many Years standing, yet extremely sound and intire; except in some few places, where the Brick it self was mouldered away. It had been made only because (being very near and directly opposite to the House) it was thought to be handsomer than the naked Earth. It made an Angle of about 60 Degrees with the Horizon; and was exposed not directly to the South, but several Degrees Westward. The Soil is not extraordinary. The House was but low, but it must needs shade that place a great part of the Day. There has been added since some pretty high Buildings to both ends of the House, which Buildings by their shade have intirely spoiled the said Vine, so that it has been pulled up. I felt the Bricks of that Slope one Day, when the Sun shone almost perpendicularly upon them, and they were exceeding hot. But those Noble Persons, to whom the House belonged, thought the goodness of the Grapes might arise from the Soil; and forgetting the Exposition, they never tryed to recover their loss by another Sloping Wall, for which the Ground would have afforded them abundance of convenient places.

And

I M P R O V E D.

2

And thus we have not only a notable Experience for us ; but we see also how easily and how cheap our Sloping Walls may be built, without any danger of their tumbling down, as our Garden-walls are apt to do. But this being a very material Point, and considering that most People may think it either very chargeable, or very impracticable, to build a Sloping Wall, let us a little enlarge upon it.

*How Sloping
Walls may
be built with
little charge.*

I conceive then that the facing the Slope of Terrasse Walks, either with a Brick-wall, such as I just now described, or else with a Wall twice, or at most three or four times as thick is the best, easiest, and handsomest way of building our Inclining Walls. Whose name ought not therefore to mislead one so far, as to make him think, that we would propose the building of a thick Wall sloping and incompassed on both sides with Air. The thicker Walls are properest when they are less sloping : for so their strength may better serve to keep the Terrasses from breaking out. It is not required we should lay the flat sides of the Bricks perpendicularly to the plane of our Wall : but it will be more proper to lay them parallel to it : So that each Bed or Floor of Bricks, of which our Wall is composed, may be only two or three Inches thick. And thus the Joynts of the Bricks may be so disposed as to leave no room for Plants or Insects to come out of the Ground.

C

After

*And how far
the Roofs of
Houses
might serve
instead of
Sloping
Walls..*

After having explained a better way, 'tis hardly worth our while to observe that the Roofs of long and low Buildings in the Country, and even the Roofs of Houses in great Towns, might also conveniently be made to serve for Sloping Walls; especially if some regard were had to it in building. So, for instance, in the Country the Roof of a long Building might on one side be brought as low as the very Ground. And thus Trees and Vines, especially the last, might be made to grow against the Roof, without spending their very strength in growing up to an immoderate height. In Cities, where they use sometimes to make one Roof to serve many Houses of one side the Street, one might, between the Garret Windows, cut out in the Roof a rectangular Space, of the same height and breadth with the Space the Windows take up; and from within one might slide up to that Space a square Box full of Earth, of a fit Figure and bigness to stand handsomely between the Windows. This Box being supported at some height from the Floor, one need not fear any inconveniency from the Water's dropping out: which, in case it should do, might be received in some Vessels. It is so easie to prevent the Rain from running in, between the Roof and the Box, that it is to no purpose to enlarge upon it. Out of these Boxes one might raise some excellent Trees and Vines,
and

IMPROVED.

II

and spread them upon some Frames disposed against the Roof. And this, besides the more substantial Advantage of yielding a considerable quantity of Fruit, would also prove a delightful Ornament to that part of our Buildings, which seems to want it most. However at *London* the Smoak of Sea-coal is much to be feared; since it both takes off the strength of the Sun, and doth settle upon Trees, where its great acrimony must needs be unnatural and pernicious. But I must give over and leave the Application of this Doctrine to every body's Industry.

I need not mention that, in the making our Bricks, some holes may be made in them to receive Pegs of Wood to serve as necessity shall require: unless you chuse rather to use those Frames the French call *des Espaliers*; which indeed seem to be much better. But it is worth observing, that such Walls as these, having no Foundation, leave in the Earth more room for the Roots of our Trees; and are cheaper built and less apt to fall. If they be not made both exceeding heavy and little sloping, I do not think that they will compress so much the Ground under them as to obstruct the growing and spreading of the Roots. And thus much is sufficient as to the manner of building our Walls.

The Advantage of their having no Foundation.

FRUIT-WALLS

Let us now see, as far as we can, how we may chuse, in any Latitude, the properest Elevation for our South Wall, and for the Fruit we design to raise.

Rule for determining the quantity of the Inclination of Sloping South-Walls.

In order then to determine what Slope is best to give, in cold and temperate Countries, to our South-wall, I look for the Sun's Meridian Altitude at least ten Days, or a Fortnight, or three Weeks, &c. before the latter half of the Fruit of the Kind I design to have uses to be ripe : and then I make the Complement of that Altitude, to 90 Degrees, the measure of the Elevation of the Wall above the Horizon. However I would not be tyed by this Rule, but that I might alter, upon the least consideration, the sloping of the Wall by several Degrees ; especially if one be afraid of taking in too much Heat. And if the Sun's Declination, belonging to the Meridian Altitude found by the Rule aforesaid, should be otherwise, I commonly reduce it so (in our Northern Climates) as to make it fall in the Space, which is from the Equator to the Parallel that goes thro' the 16th or 20th Degree of North Latitude. The longer the Fruit is a growing ripe, and also the more distance of time there is between the first and the last ripe Fruit of the same Tree, the more Days would I allow backwards in the finding the Sun's Meridian Altitude, and Declination : Indeavouring by this to make, for the most part, the strongest Heat of all to fall some-

something before the middle of the ripening time. For the Degree of Heat, that arises barely from the Exposition, is during many Days sensibly the same, and as it were at a stay, when it is at the greatest. And we must, for the most part, endeavour that, when our Tree makes an end of yielding its Fruit, especially if this be about the latter end of the Year, the Sun may already, by changing its Declination, have been withdrawing it self some 5, or 10, or 15 Degrees from the Line perpendicular to our inclined Plane. Thus all the while the Fruit is growing ripe it will enjoy the greatest Heat.

But let us inquire more particularly after the Limits of the Elevations of South-walls : so that we may resolve to keep them, in each Climate, within the two Extrems we shall find.

I should not easily chuse to make any where, except perhaps in extraordinary high Grounds, the South-wall more sloping than an Elevation of about 30 or 40 Degrees upon the Horizon would make it to be. For, tho a great obliquity of the Wall would not hinder Vegetation, but rather, for ought I know, forward it ; yet, our experience in this kind being so very narrow, I cannot know otherwise, than by guess, how the Elevations of only 10 or 20 Degrees upon the Horizon would agree with Plants. However such small Elevations are not fit for South-walls, in these

Coun-

*Of Sloping-
Walls in ve-
ry hot Coun-
tries.*

Countries. But, if there were any use for our South-walls in the Torrid Zone, as there may possibly be for those Fruits, which, being peculiar to that Climate, require also a great deal of Sunshine to bring them to perfection, especially in the higher Situations, upon some Hills or some Mountains, I should even there chuse not to give these Walls less than 40, or 45 Degrees Elevation: which sloping would perhaps give but too much Heat. For there is some reason to doubt whether it would not scorch any Plant whatsoever, that is set, in these hot Countries, against a Wall very much inclined. So I should leave the most sloping South-walls for the Climates that have about 40, or 45 Degrees Latitude: and not use them there neither, but upon Mountains, or for the Plants of hotter Countries. In *Iseland*, which is placed under the Polar Circle, the inclined South-walls must make an Angle of more than 46 Degrees, and less than 66½ Degrees with the Horizon. Generally, in all the temperate Zone, I should limit the Elevation of the South-wall between 30 and 66 Degrees. These several Considerations must be duly weighed together, as well as the tenderness of your Plants, in order to chuse a properer Elevation. But a small error in this is not of great consequence, if you intend to raise all the Heat possible. For you can indeed erre considerably but one way, to
wit,

IMPROVED.

15

wit, in procuring too much Heat. If you do not fear to exceed in this, you may follow the Numbers of this Table ; where the first Column gives the Latitude or Elevation of the Pole ;

A Table giving the Limits of the Elevation of South Walls in Temperate Countreys.

Latitude. Deg.	Greatest Elevation of the South Wall. Deg.	Least Elevation of the South Wall. Deg.	Least Elevation corrected. Deg.	Middle Elevation. Deg.
40	40	20	30	35
50	50	30	35	42½
60	60	40	40	50
70	70	50	50	60
I	II	III	IV	V

The second Column gives the greatest, and the third Column the least Elevation of the South Wall upon the Horizon. The fourth Column gives the same least Elevation, with some Corrections, that are not made in order to increase the Heat, but, at the expense of some Heat, to give (in smaller Latitudes) more Elevation to the Wall. The fifth Column gives only the middle Numbers between those of the second and fourth ; never differing from them one way or another more than 10 Degrees. The Table was made from this Rule, That the Elevation of the South Wall, in temperate Countries, ought,

in order to make the most of the Sun's Heat, neither to be more than the Height of the Pole, nor less than the Height of the Pole wanting 20 Degrees.

So then the second and fourth Column may pretty well serve, especially in great Latitudes, for Limits of the Elevations of our warmest South Walls. But the Elevations, for hottest Countries, cannot be so well determined, till Experience has taught what may and what may not be done there. In those hot Climates the Rule I gave just now is of little or no use. For it supposes that Fruits are ripe by the end of *October*, or long before. But in the Torrid Zone we may have Fruits all the Year round. In great Latitudes the Sun in Autumn and Winter shines seldom, and always thro' a great depth of Air; which inclines one to neglect that insignificant Sun-shine, and to make the most of the Sun-shine in the Spring and Summer; by keeping the South Walls, as our Rule does, rather more sloping than they needed have been otherwise. But pretty near the Equator the Sun comes every Day to a considerable Height. And that invites one not to neglect the Sun-shine so much during Autumn and Winter, and by consequence to make there the Walls rather less sloping. Which the scorching Heat requiring also, all these Reasons seem to prove that the South Walls must again grow

*It is difficult
to determine
those Limits
in very hot
Countries.*

rather more upright, as one comes nearer the Equator. For let it ever be remembred to consider whether the Climate, the height of the Situation, the Soil, the Exposition, the Nature of your Plants, and the Season of their growing be such as to permit you to give your Sloping Walls the most Heat you can procure.

As to the Use of the Table, the Fruits that ripen in Autumn, and very late in the Year, require the greatest Elevations; those that ripen in *June*, or *July* the least. Such as grow ripe in *May* will have almost the least Elevations: and such as grow ripe in *April*, *August*, and *September*, require some middling ones. But if any Fruit, such as Pease &c, are to grow ripe in *March*, they require again the greatest Elevations. Now all this is said upon supposition that you are in no fear of procuring too much Heat. And this is what we can at present determine about the Limits of the Elevations of South Walls.

Before we proceed farther, should not we relate, as an Experiment favouring our Inclined Walls, that where Vines do grow in the open Air, they chuse to Plant them not upon a flat, but upon a rising Ground, exposed to the East, or South-East, or South? Which sloping of the Ground, consonant to the Theory I have been proposing, is found by Experience to be of

*The Use of
the Table.*

*Vines are
commonly
planted up-
on a rising
Ground well
exposed.*

an extraordinary Advantage. And to this must also be referred what Monsieur *La Quintinye* has writ concerning the Exposition and Declivity of the Ground for great Gardens. But, if after all there should be left some Scruples in the Reader's Mind, let him either examine the Demonstrations I shall give in this Discourse, or cause some proper Judge to tell him how far he may rely upon them.

Having then no reason to think, but that our Theory will be found agreeable to Nature, we may see farther how it can be brought to an extended and easie Practice.

If any body therefore is desirous, particularly in a Country not exposed to some returns of Frost in the Spring, and to blasting Winds, to raise a pretty deal of good Fruit, either for his own use or for the Market, I would advise him, both as the best and the least chargeable, to chuse, in a very good Soil, especially in the side of a narrow Vale, a convenient Hill or Rising, with a pretty strong Ascent, and exposed to the South South East, or to the South and by East, or to the South, or to the South and by West, or at least not far from these Expositions: and to dispose his Ground by Terrasses, one above another, so that, in the Latitude of *London*, the sloping of the Terrasses be elevated upon the Horizon, for the South Wall, neither less than 36,
nor

*A Hill well
exposed cut
into Terras-
ses with Slo-
ping Walls
for Fruit.*

nor more than 52 Degrees. See the Figure I, *Fig. 1.* where the Section of those Terrasses is represented, in two several Places, to the Eye. And here you may take notice that, if the Ground be not very steep, the less the Sloping Wall is elevated upon the Horizon, the less Room, all things being alike, each Terrasse will take, and the less charge will be required. In the making of these Terrasses a sufficient quantity of the good Earth must be carefully gathered along the Ridge of each Walk, there to receive and nourish the Roots of our Trees. Neither is it necessary to be very curious in keeping your Terrasses, or Sloping Grounds, straight and parallel. But you may follow the winding of the Hill, provided it keeps within the extent of good Expositions: and take every where so much breadth as dos most conveniently give your Terrasses the Height you require. Thus the Expence will not be considerable; and even the plain Country Man may not think it above his power; especially if he dos his Work by parts, and in several Years. And I am much mistaken, if even those irregular Terrasses do not prove very pleasant and entertaining to the Eye. A *Something like this done in China, but for another reason.* late ingenious Account of *China*, tells us how agreeable the prospects of their Hills are, which the Country Men divide into several Levels, parted by a Sloping Ground between. All

this trouble is taken, in that industrious Country, in order to keep the Rain from running off their Fields. But here we shall have probably more occasion to think how we may not be troubled with too much Water; and how that of the upper Terrasses may be prevented from falling into the lower ones: which being always easie to be done, and the Remedy depending, in a great measure, upon the Extent of the Ground, I must here forbear any farther Discourse.

Fig. I.

A considerable Declivity to the South in a large Garden may be turned to much advantage.

Thus have I brought our Theory to some consistence, and shewn how it might easily be reduced to Practice. But while the first Figure is under our Eyes, I cannot but observe, that instead of looking with others upon a great Declivity towards the South as a considerable inconveniency in the Ground for a great Garden, I should rather admire it, for the multitude of Sloping Walls, well exposed, it would afford from place to place; besides the pleasantness of many Walls breast high, and of a good prospect abroad. And as to the shade for Walks, one might have it at the top of all from some rows of Trees.

I will here add some Reflexions, I chuse among a great many, by which we may farther compare Inclined Walls with perpendicular ones. For I should swell this to an unreasonable Bulk, should

should I speak of all the Calculations I have
 made relating to this matter. I shall only then
 observe that, from the Equator to the very Pole,
 that is in the whole Terrestrial Globe, I find
 not one Place, and not one Exposition what-
 soever, in which a perpendicular Wall is so hot
 as a Wall sloping to a proper Degree for the
 Exposition. And, whereas the North Exposi-
 tion is utterly naught, in our ordinary manner
 of building perpendicular Walls, if in the Lati-
 tude of $51\frac{1}{2}$ Degrees a North Wall be elevated
 only $38\frac{1}{2}$ Degrees upon the Horizon, it will in-
 joy the Sun, tho' much sloping, for every Minute it
 can shine in the whole half Year, from the Spring
 Equinox to the Autumn Equinox. But during
 the two Months and three Days about the Sum-
 mer Solstice it will injoy the Sun with an Eleva-
 tion, or Inclination, ever greater than of 20 De-
 grees: which gives more than the ninth part of
 the full Action of the Sun. And for ought I see
 that may be near as much as our ordinary
 South Walls do then receive. This might serve
 for the Summer Fruits that are ripe about the
 end of July, and for raising of Pease, &c.
 For tho' one would not chuse to build such a
 Wall without some necessity, or some other con-
 siderable advantage, yet having it at hand one
 would not leave it without use. The North
 Exposition dos mend very fast as the Countrey
 lies.

*A perpendi-
 cular Wall in
 no Countrey
 so hot as a
 Sloping Wall
 proper to the
 Place and
 Exposition.*

*The North
 Exposition is
 made tolera-
 ble by a Slo-
 ping Wall.*

lies more Southerly : And above all others it dos require, in temperate Countries on this side the Equator, Walls with a very small Elevation, such as 25, or 30, or 35 Degrees. So then we find that even the very worst of perpendicular Walls may become tolerably good, if they be made sloping.

It will appear, by the sequel of this Discourse, how many Advantages, besides the bare Increase of Heat, do follow our building of Sloping Walls : But one of them lies already too obvious not to be spoken of here.

*Use of Slo-
ping Walls
for having
Fruits, Me-
lons &c, ear-
ly and tho-
roughly ripe.*

I say then that this Contrivance seems to be of an extraordinary consequence, for the raising of all sorts of Fruits something earlier than we use to have them, and for their perfect ripening : And that it may prevent some of those, that are fond of Fruits, from falling into the Diseases that usually follow the eating Fruit not thoroughly ripe. I expect from these Walls such Melons, and Figs, and Grapes, as, I think, have never been seen in this Country. I forbear speaking of other Fruits ; but shall only say that, if we had once some excellent Kinds of Trees raised by this Method, we might not need to send for new Graffs again to *France*. And if, the Summer being extraordinary wet and cloudy, our Sloping South Wall should bring forth but indifferent Fruits, yet even then those Fruits will
be

be more tolerable than such as we gather from our ordinary Walls. But all this will become more evident, when the Principles I build upon shall be laid down.

There is yet something I have to say, both in reference to the properest matter to build our Walls withal, and to some other circumstances in the manner of building.

As to the properest Matter for our Walls, I think Brick to be much better, in this Countrey, than Stone: because they grow hotter, and keep much longer the Heat. By which means they do still warm the Plants a good while after the Sun is hid under a Cloud, and, in a manner, lost to other Walls. I know nothing that is more convenient than they are, or of a better Shape for our purpose. The biggest and thickest Bricks will be best: And I should chuse, as I said before, to dispose them so that they might appear by their broadest sides. Thus the Wall will be cheaper, the Bricks will be apt to grow warmer, and, their Interstices being fewer and less deep, there will be less room to take care of against Insects finding a shelter there. Walls of Slate, or of any dark coloured Stone, whether natural or painted, will also be very good. For these Colours imbibe the Light, or Heat, much more than Colours that are whiter.

Walls of Bricks are best in England.

Of Walls of Slate, or of any dark coloured Stone, whether natural or painted.

Our

*Sloping
Walls not to
be clogged
with any
Shade, except
perhaps in
Winter, or
when the Sun
is very low.*

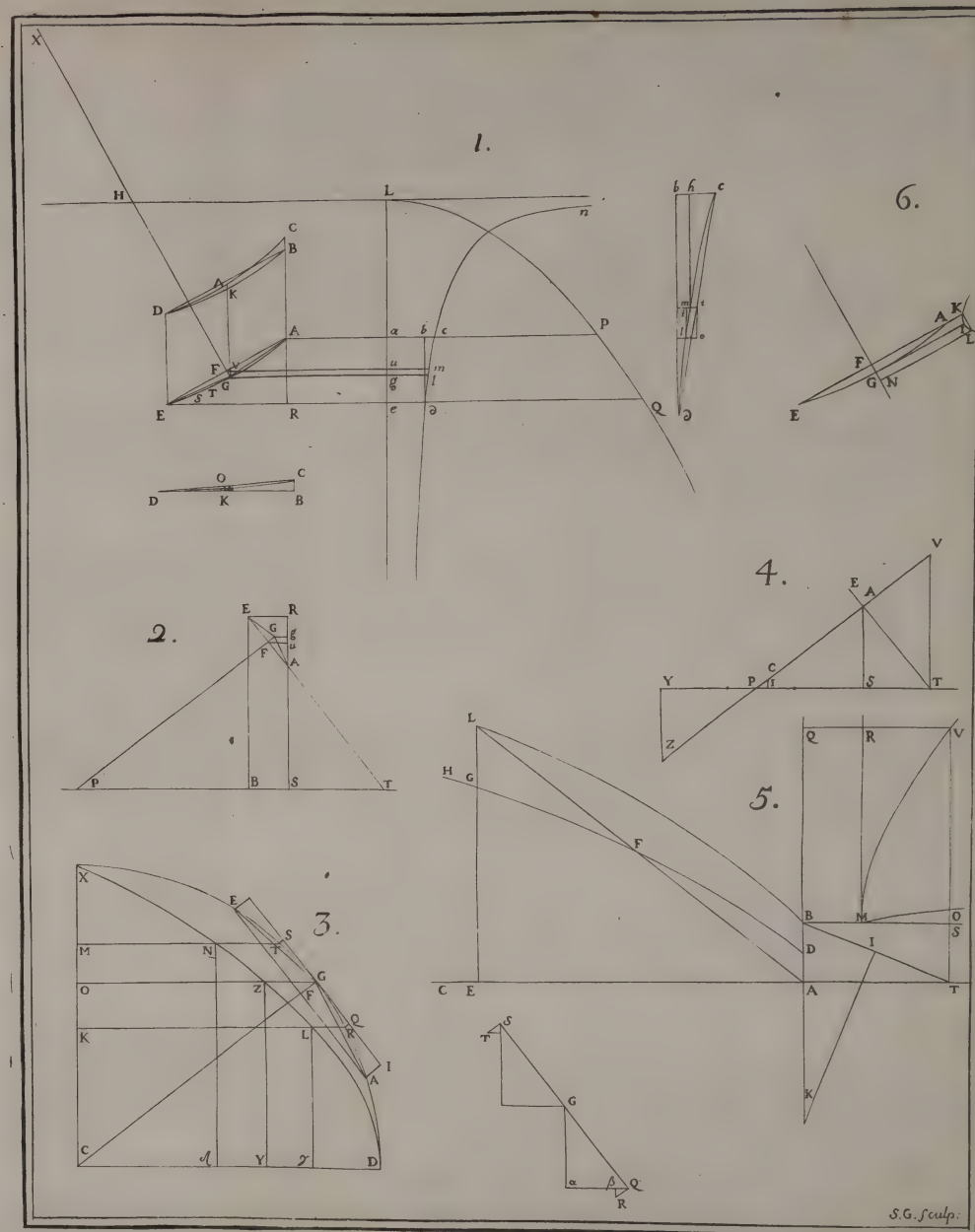
Our Walls ought not to have any Building raised from the top of them; nor any other Shade cast upon them in Vegetating time, by the Interposition of any thing standing, on either side of them, between them and the Sun. But if they be deprived of the sight of the Sun, while it is only within a few Degrees from the Horizon, the loss is not considerable, and abundantly made up, if, at the same time, they be secured from Winds.

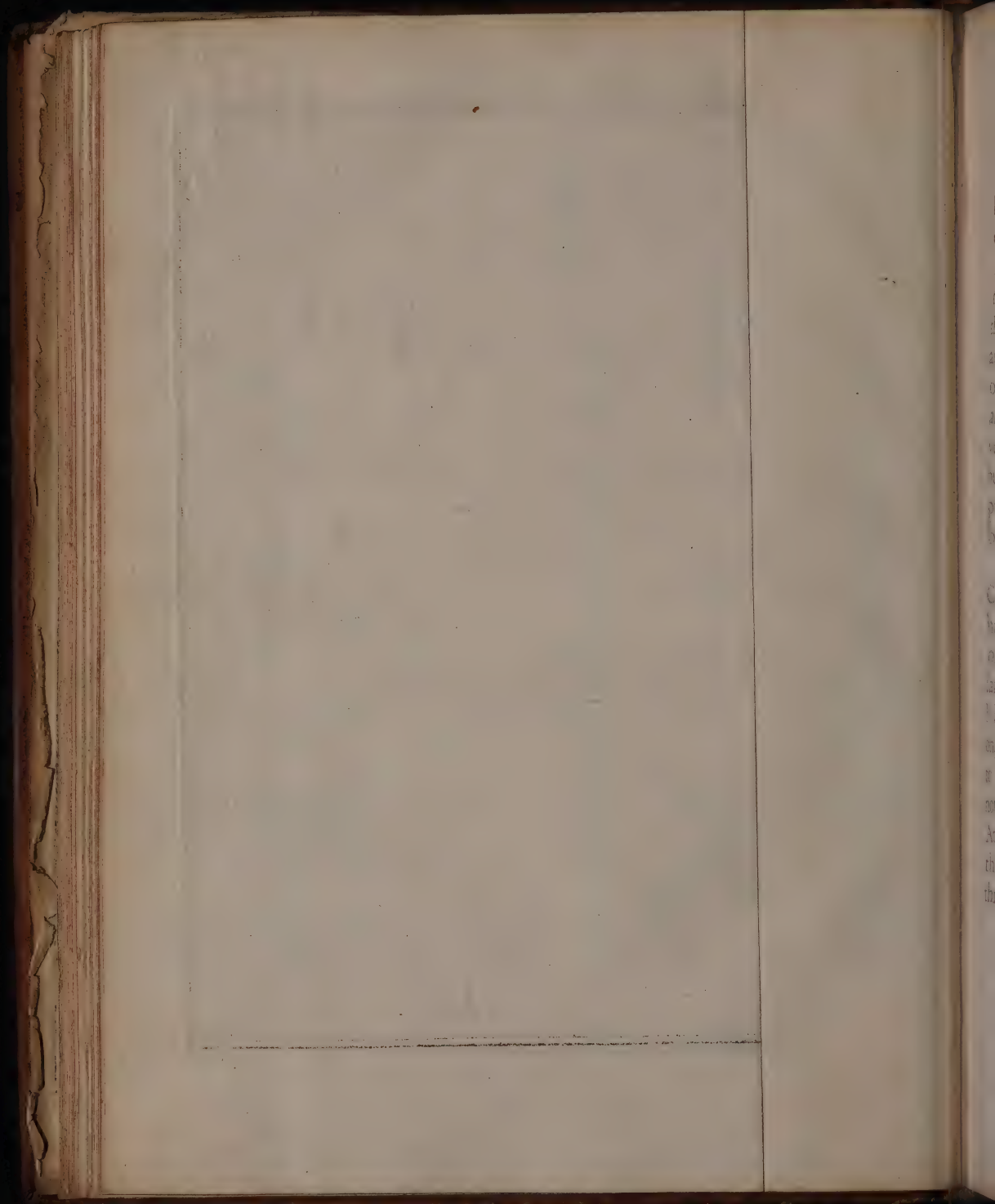
*Sloping
Walls may
ascend ob-
liquely upon
a Hill; and
the use of
making them
so.*

The Foundation, or rather Bottom of Sloping Walls needs not be horizontal; but it may ascend obliquely upon a Hill by some Degrees. Which is of some conveniency for the running off of the Water, and for the chusing a South Exposition upon a Hill that looks to the South-East, or South-West, or to any other point, either between, or, at least, not much above 45 Degrees distance from these places. For the most part of the Spring and Summer such a Wall will enjoy as much Sun, as if the Foundation had been horizontal; but the Ground at the Foot of it will enjoy less. And this is what I had further to mention as to the way of building our Sloping Walls.

*Many Slopes
in several
Gardens are
ready made,
and fit for
Sloping
Walls.*

I have seen, in many Gardens, and other places, some Slopes of Earth ready made, and fit every way for Trees to grow against them, if they had been but faced with Bricks. But they lay





lay neglected, perhaps because the good Use that might be made of them was unknown.

If any were apt yet to think that there can be no great difference between two South Walls, of which the one receives the Light of the Sun much fuller and longer than the other; let them consider that, upon the very same Soil, the South-side of a Wall is as good for Fruit as the North-side is bad. That the East-side of another Wall is very good, at least in France, and the West-side but indifferent. Which diversity can certainly be attributed to nothing but the Exposition; and makes it more than probable that by so much as this is mended, by so much Fruits ought to be more perfect.

The goodness of a Wall proved owing in a great measure to the Exposition.

I have given to this Theory some of the Commendations it justly deserves, knowing how hard a matter it is to persuade People to go out of their ordinary way: And I wish I may have said enough to bring it into common Practice. I hope this is not out of any vain Ostentation, since I chuse to publish here what I know to be much inferiour to some Meditations of another Kind, I have had these many Years by me. And thus much I beg leave to say; lest a thing that might be useful should be neglected and thrown by, before it be understood.

The Author's Design in commending this Theory.

E If

The Advantage for Vegetation of a close and warm Air ; and of small and narrow Gardens.

If the vegetation of Plants did only depend upon the Sun-shine coming freely to them, there would be but little occasion left for any farther Improvement. But it is well known that a warm and pretty close Air, well sheltered from Winds, tho' not so much exposed to the Sun, in a word, such an Air as is found in the Gardens at Paris, and other great Cities where they do not burn Sea Coal, dos often bring forth better Fruit than will be found in other places, in the Neighbourhood, tho' better exposed. However, at the same time that we get wholly the advantage of Sloping Walls, we may also keep all others, and secure those Walls from cold and dangerous Winds. This makes me recommend Gardens of but an indifferent bigness, with high Walls to them : being willing to purchase a close Air with some little loss of Sun-shine. But if the Gardens be very narrow, as I should for the most part chuse, the Walls may be less high. The breadth of your Gardens ought not be the same in all Expositions. And it is of great consequence that the length of very narrow Gardens be from East to West, and not from North to South. In disposing thus the length of the Garden, the Wall may be from 8 or 10, to 15 Foot, or a little more, in the Slope : the breadth of the Garden, or Earth, between the Walls, from 11 or 12, to 50 or 100 Foot :
and

and the length as great as you please. But the smallest Breadths are best : And those, as I said, do not so much require high Walls : and by consequence will not be so chargeable. In Gardens that run from North to South, a very small Breadth will be as prejudicial as it is good in Gardens that run from East to West. For it is easie to see that, in these last, the Shade of the long Walls upon each other is but little, in vegetating time; and falls either upon the shortest Days, or upon such Moments as the Sun is but low and weak. But, in Gardens that run from North to South, and are of the same breadth with the former, the Shade is more considerable. ' And ' I find that such Gardens, having an East Wall ' and a West Wall, each with an Elevation of 30 ' Degrees, and each of 7 Foot in perpendicular ' Height, must be 68 Foot wide, from Wall to ' Wall, if you will that neither Wall should take ' from the other the sight of the Sun, but when ' it is less than 5 Degrees high.

Left any one should wonder at this extraordinary narrowness, which dos often turn what we called a Garden into a narrow Walk, I will shew that I do not chuse it without securing that great advantage of a warm and close Air : In order to which I give here the Section of a Walk, or narrow Garden for Trees, whose length runs East and West. Let the South Wall *AB* have a

E 2

pro-

Fig. II, III.

*How to make
some Terras-
ses running
from East to
West, so that
the Air be-
tween be ex-
treamly
warm;*

proper Elevation for your Climate, and for the Fruits you design to have; suppose at *London* an Elevation of 45 Degrees. That Elevation is good for those Trees, whose latest Fruits are ripe near the 20th of *September*, 'when the Sun is about 3 'or 4 Degrees South Declination: at which time 'the Sun is already withdrawn about 10 Degrees 'from the perpendicular to the Wall *AB*. Let the perpendicular Height *BC* of your Wall be for Instance, of 7 or 10 Foot; 'which will give '9.9, or 14.1 Foot in the Slope *AB*, and 7 'or '10 Foot in the horizontal Line *AC*. Let the Line *AD* be in the Plane of the Equator: and it will make here at *London* an Angle of 38.1 Degrees with the horizontal Line *AE*. Make the Breadth of your Walk the narrowest you can. Allow, for Instance, four Foot to the Ground that is to receive the Trees, and to be now and then cultivated: three Foot to the Walk or Path; which ought, of right, to be dug up every Winter: four Foot more to another Line of cultivated Ground. So you will have 11 Foot for the whole Breadth of your Walk *AE*. Draw from the top *B* of your Sloping Wall an horizontal Line *B DG*. Draw also the Sloping Line *EG*, representing your North Wall, and make it, if you please, parallel to the Plane of the Equator; or rather, if you think fit, make it yet more inclined to the Horizon, I mean more

more approaching to it, by some 10 Degrees. Make the tops of your Terrasses GH , BI , of what Breadth you please; suppose of 1, 2, or 3 Foot. But they must be broader if you intend them for Walks. Draw the new Slopes HK , IL , either parallel to BA , GE , or else with what alteration you think convenient. And so you have two Terrasses; to which you may, upon the same Level, and at convenient Distances, add as many more as you please. Now it is evident that the Heat of the Sun, being at the same time reflected, in the Spring and Summer, by both the Walls, will warm extreamly the Air $ABGE$; and, in all probability, give a much closer Heat than is in great Cities: especially if; to break the Winds, you have; from distance to distance, another Terasse running from North to South, between those I have described. These Terrasses have a double advantage against Winds; in that they receive them more sloping, and also reflect them upwards: So that the first Terrasses are a pretty good Shelter to defend the following ones. If the Ground be falling or hanging towards the South, the top GH might be kept lower than the top BI ; or the contrary done if the falling be to the North and but little. For I would chuse, except in hot Countries, to avoid any other North Exposition.

In case you should desire to make your Walls higher, you might, for instance, increase by a quarter the Lines in each of the Figures; or else increase them in any other such proportion; and keep the same Inclinations as before. 'So you might make AB of 13,2 Foot, and AE of 14,7 Foot; or else AB of 18,8 Foot, and AE of 14,7 or 20 Foot. Only the cultivated Ground needs not exceed 5 or 6 Foot; and the Path may be accordingly increased as it lights.

Terrasses to be made higher when they are far asunder.

On the other hand, in case your Walk be made a pretty deal wider, it would, at the same time, be proper that your Sloping Walls should be made higher, tho' in a less proportion than the Walk is increased. And this is in order to procure more closeness to your Air, and to have both more Sun-shine and a better Shelter against Winds. So, for instance, if you make your Walk four times as broad as it was supposed in the second and third Figures, and your Wall higher only in the proportion of 4 to 3 than it was already, the Foot of your Wall would not, after that change, lose half the Sun-shine it should have lost before. And the Sun, of which it would be deprived, being ever very low and oblique, it would yet amount to much less as to the loss of Heat: Especially almost all that loss falling upon the shortest Days, and coming to nothing near the Equinox.

But

But those extraordinary Banks would perhaps be more chargeable, as they would also be more lasting, than two bare Roofs, like those of Houses, and supporting, instead of Tiles, a Brick Wall. Which Roofs would also yield under them a Space that might be turned to some use. The greater those Banks or Roofs are, the greater is the quantity of Rain brought to the Foot of them; and the closer and stronger is the Heat. Unless, for the conveniency of a Garden between, you should remove them farther asunder. Such a Walk as I have described would also be good for raising in it those rare foreign and Medicinal Plants, that require more Heat than the Climate dos give. And I don't doubt but Orange Trees may grow there in the nature of Standards, provided; in Winter, the place be secured from Cold: which is not impracticable. However we have what we aimed at, the closeness of Air, and Walls pretty well secured against dangerous Winds.

I cannot here dissemble some faults of our Sloping Walls. For, as they have several very great advantages, so on the other hand there is in them some inconveniencies, which I could heartily wish were otherwise. However these last are not at all able to ballance the former; as will easily appear to any one that reads impartially this whole Discourse.

Let

*Roofs may be
used instead
of Terrasses.*

*Of Plants of
hotter Coun-
tries.*

*Of Orange
Trees.*

*Of some Ob-
jections a-
gainst Slo-
ping Walls.*

*Sloping South
Walls expo-
sed to the
mischiefs of
latter Frosts,
unless pre-
vented.*

Let me first mention one very considerable Objection, against our Sloping South Walls, in those cold Countries, where the passage, from cold to fair Weather, is not, as in *Denmark*, quick and certain; but the Air is subject, as here, to some returns of Frost, after it has been fair for a good while. And that is, that the Heat of these Walls will probably make the Blossoms of some Trees to come out too soon, and expose them to an evident danger of being spoiled by the latter Frosts. To this Objection I have little to say, but that it dos already grant a great deal in favour of our Walls: and that we may take our chance, as others do; there being but a few Days more of danger, for our South Walls, than for those of other people; whose Blossoms are like enough to be spoiled when ours are. Let us also remember that, in those Climates, a kindly and natural forwardness, together with a perfect maturity, owing not to our artificial Fires, but to the light of the Sun, is hardly to be had, but at the rate of running that hazard. Let us then, as I said, try our Fortune; and in the mean while use, if we think fit, all the Remedies Agriculture dos afford, to keep back this early Vegetation, and to prevent the mischiefs of Frost: for which I refer you to the proper Authors. * However here is an easie Remedy we may use, not only against this too great forwardness, but also against Winds. Sup-

*Of Remedies
against an
early Vege-
tation and
Winds.*

** See La
Quintinye.*

Suppose we make but few parallel Terrasses, all of them running from East to West, for instance, but two, or four, &c. Let, in the II Figure, *AB* represent the South Wall of the Northernmost Terrasse, and *EG* the North Wall of the Southernmost Terrasse. Prolong upwards, indefinitely, the Lines *AB*, *EG*, in *M* and *N*; and prolong also the Horizontal Line *EA* Northwards in *O*, and Southwards in *P*. You may fill all the Angle *MAO* with Trees, and very tall and thick Hedges &c, without any injury to the South Wall *AB*, and the Angle *NEP*, without any injury to the North Wall *GE*. And yet both the Walls *AB* and *EG* will, for six Months together, enjoy the Sun-shine, for twelve Hours or more. Now this Remedy is better against Winds, and against the forwardness of blossoming, than against the forwardness of Fruits; and, by consequence, is so much more to be valued. Thus several Ridings might be made in a large Forest; provided the Ground were not already worn out; or that it were put in heart again.

Another Objection against our Sloping Walls, is, that in the Spring, in some cold Mornings, the Dew may sometimes fall, in great plenty, upon the Blossoms, and there freeze, as it falls; which might endanger them, and blast all our hopes. I confess, I do not know how far this mischief is to be feared. But this I may say,

F

that,

Fig. II.

*Sloping
Walls are
exposed to
one sort of
white Frost.*

that, in the coldest part of the Spring, the Sun shines upon our Terrasses, from the time it begins to be some few degrees high; and, by consequence, soon after the Dew is fallen. So that there will be no time, at least in fair Weather, without which we have commonly no Dews, for much harm to be done: Especially the Vapours, or Steams, that arise from the Ground, being more like to disperse in the Air, than to condense against our Trees; as I shall explain hereafter. However this inconveniency being already too much felt in ordinary Gardens, the Remedies against it are found, and well known; at least by such as raise some early and tender Plants, at the latter end of Winter.

*They are
much expo-
sed to Hail.*

Our Walls are also more exposed to Storms, and Hail, than ordinary Walls. Yet this ought not to deter us. For we shall not have this accident every Year, at such times, when we may fear it. And, if we should have it, yet it is to be supposed that many of our Fruits will escape being spoiled. Neither is it impossible to cover such Trees, as are most precious, when there is any prospect of a Storm.

*Of the Trees
growing ob-
liquely to the
Ground.*

I expect some will object also, that, the natural posture of Trees being to grow upright, their leaning against a Bank will be like to disagree with their Vegetation. But this Objection has not that strength in it, which is in the
for-

former; and might well have passed under silence. For it is a common thing, in our Gardens, to force Trees into a Figure not at all natural to them. And even Trees, that grow in the open Air, have some of their Branches bending downwards; and most of them in a manner parallel to the Horizon. It was ordered wisely, for the beauty and stability of Trees, but not for their fruitfulness, that they should naturally grow upright. Now these first considerations ceasing, in an Inclined Wall, I do not doubt but that, as to the production of Fruit, Vegetation will have there its ordinary course.

It has been twice objected to me that the dampness of the Ground would probably spoil the Fruits growing against our Sloping Walls. Which makes me take notice of this Objection, for otherwise I should have neglected to give it an answer. I say then that either this inconvenience is not at all to be feared; or, if it be, that the Remedies are obvious and easie. I do not fear it in such Terrasses as those of the II, III, and XIth Figures; especially when they are well exposed. For I cannot see what mighty store of Dampness can come, or be kept there; since water naturally runs off of such heaps. But as to the lower Terrasses of the first Figure, if one or two beds of Bricks be not enough, at least three or four such Beds, and what else one

*Of the damp-
ness that may
be objected a-
gainst Slo-
ping Walls.*

pleases underneath, will be sufficient to make the Wall remain dry at the outside. Moreover it is not necessary that the Fruit should touch the very Wall. But in case it should grow too close against it, a thin Slate, or a small Ring, of any proper matter and shape, will easily keep it from the Terrasse. After all I think Experience, to which I must appeal, will add no strength to this Objection.

Of their being exposed to Mice and Ants, &c.

Some have urged, against our Walls, that our Fruit will be eaten up by Mice, or by Ants, &c. Tho' I might say that all other Trees are exposed to this very mischief; for 'tis known that those Mice and Ants can easily creep upon them, yet to this, and all other Objections, I will give but one general Answer. I ask whether the inconvenience that is objected be real, necessary, general, and unavoidable? or else whether it be not, in a great measure, imaginary? I ask whether there be no Remedy left against it to our Care and Industry? I ask, when all is granted to the Objection that can be given it, whether there will be nothing at all left for us, but Trees without Fruit? 'Tis true that I ought by so much more to fear the resort of Insects to our Fruits, as they are like to prove more excellent than others are. But it is well for us that the first Inventers and Improvers of Arts have not at all been moved by such Objections

Of all other Objections against them.

as these. Are they greater than such as may be made against a Countrey-man, who would sow his Grounds? How is he secured against the vexations of troublesome Neighbours, against the Invasions of an Enemy, the mischiefs of Civil Wars, the unfaithfulness of Servants? How can he depend upon fair and seasonable Weather; without too much Drought or Rain, without Hail and Storms and strong Winds? May not his Seed be eaten up in the Fields; may not his increase be stolen away from him; or destroyed by numberless sorts of Insects? What shall I say of the mischiefs of Fire? What of Taxes and Tithes? What of the price of Rents and Leases? What of selling one's increase to such as will not, or cannot, pay their Debts? What of all other fears and troubles that may come upon this poor Countrey-man? Yet for all this our Fields are ploughed, we are nourished, and our Barns are filled with Grain. Such is the Profusion, with which God Almighty provides for us, that, after all deductions made, we have enough to bless his Munificence, and to live with plenty.

Now having, in some measure, satisfied the curiosity and impatience of the Reader, I may proceed to shew how I calculate the proportion of Heat, I gave before, between a Perpendicular and a Sloping South Wall; and treat at large of the
Prin-

Principles and Method, upon which those, and the like Calculations, are grounded : endeavouring to make our Doctrine as general and as exact as the Nature of the Subject will bear.

Calculation shewing for an Example the proportion of Heat at the Solstice, in the Latitude of $52\frac{1}{2}$ upon a perpendicular Wall, and a sloping smooth South Wall, passing thro' the Pole.

Fig. IV. The Ground and Method of this Calculation.

I begin with Calculating, for the Parallel that lies one Degree North of London, the proportion between the Actions of the Sun, in the Summer Solstice, upon a Perpendicular, and upon an Inclined smooth Wall, with an Elevation of $52\frac{1}{2}$ Degrees ; which is an Inclination very good there, for the Fruits that are ripe in the Month of October, or the latter end of September. For other Fruits that Elevation is rather of the greatest.

" The Circle $PTEP$ described from the Center C represents the Celestial Sphere. CH is the Horizon ; P the Pole ; CE the Equator ; IT a Parallel to the Equator, as suppose here the Tropick of Cancer. CIP is the Plane of the Inclined Wall ci ; CM the Plane of the perpendicular Wall cm . Upon the Circumference of the Parallel TI I suppose a right Cylindrical Surface elevated and prolonged of each side as far as is necessary : Which I do in order to find upon it the proportion of the Sun's Heat.

' Now it is easily known that the Quantity of Rays, falling from the Sun upon any Plane, is as the Sine of the Sun's Altitude on that Plane.

' And

‘ And that the Force of each Ray, coming from the Sun upon a Plane, is also as the Sine of the Sun’s Altitude on that Plane.

‘ From whence it follows that the whole Action of the Rays, upon a Plane, is as the Square of the Sine of the Sun’s Altitude on the Plane, and the time that Action lasts, joyn’tly : neglecting the Effects of the Atmosphere.

‘ Let now the whole perpendicular Force of the Sun, upon a Plane directly exposed to it, be expressed by the Radius CE , which is Unity divided into 10000 parts. The Force of the Sun at the Meridian in T upon the Wall CI , will be as the Square of the Sine TI ; that is, supposing still CE for Unity, as the Line Tv equal to 8410 parts ; which I take upon the Cylindrical Surface Northward. Now from the Vertex I , upon the Axis IP , I draw thro’ the Point v the Parabola INv . And the Lines or Ordinates as Tv , MN &c, drawn parallel to the Axis IP , from any Point as T or M in the Line IT , till they meet the Parabola IV , express by their Lengths Tv , MN the Action of the Sun in the Tropick, in T or M &c, upon the Sloping Wall CI . The Sum of all those Lines till Noon is the Cylindrical Surface $ITvI$, which gives the whole Heat of the Morning Sun upon the Sloping Wall CI , secluding, as before, the Effects of the Atmosphere.

“ Now

FRUIT-WALLS

" Now from the Point T drawing a Parallel
 " to the Horizon, till it meets with the Line $C_m M$,
 " make the Line TL opposite to TV equal to
 " the Square of that Parallel; supposing still
 " Unity to be expressed by CE . And in our Ex-
 " ample you will find TL equal to 2350 parts.
 " Draw the Parabola ML , of which M is the Ver-
 " tex, MT the Tangent at the Vertex, and L a
 " Point thro' which that Parabola passes. The
 " Ordinates, such as TL , will give, for every cor-
 " respondent point of the Circle TM , the Action
 " of the Sun upon the perpendicular Wall C_m .
 " And the Cylindrical Surface $MTLM$ will give
 " the whole Heat of the morning Sun, upon that
 " perpendicular Wall, excepting only the Effects
 " of the Atmosphere.

" Make the Point M the Vertex of another
 " Parabola, of which MT is the Tangent at the
 " Vertex, and v a point thro' which the said Pa-
 " rabola passes. It is evident that the Cylindri-
 " cal Spaces MTV , MTL are to one another as TV
 " to TL , that is as 8410 to 2350, or as 3.58
 " to 1. And that proportion obtaining for eve-
 " ry Point in the Arc MT , it is clear the Heats
 " arising from thence keep that very proportion
 " upon the Walls; notwithstanding any variety
 " you may suppose in the Thickness and Effects
 " of the Air, thro' which the Light is to come
 " from different Altitudes.

But

"But there is yet all the Heat expressed by
"the Cylindrical Surface MVI to be accounted
"for.

"The Proportion between the Arcs TM ,
" TI will be found, by the help of their Versed
"Sines, to be as 100 to 127.6. And the Pro-
"portion between the very small Arcs tm , ti will
"be found as 100 to 122.1: which depends up-
"on the Proportion of the Line TM to TI be-
"ing as tm is to ti . And if upon TV you take
"the Point τ , which is three times farther from
"V than from T , and thro' that Point you con-
"ceive the Circle $\tau\mu i$ parallel to TMI , and meet-
"ing the two Parabolas in μ and i , you will find
"the Proportion, between the Arcs $\tau\mu$ and τi ,
"as 100 to 124.1.

"So then one cannot err sensibly with suppo-
"sing the whole Cylindrical Space $MTVM$ to
"the Cylindrical Space $ITVI$ as 100 to 125, or
"thereabouts; that is as 8410 to 10512; which
"stands for the Cylindrical Space ITV , suppo-
"sing the Cylindrical Spaces MTL , MTV to be
"2350 and 8410. And the Number 10512
"being divided by 2350, you find the Cylin-
"drical Space MTL to the Cylindrical Space ITV
"as 1 to 4.47. But this Number is to be some-
"thing diminisht, because of the different Trans-
"parency of the Air for different Altitudes. IMN
"is very considerably less than the $\frac{1}{3}$ of the Cy-

G lindrical

“lindrical Space ITV : and it is upon IMN , and
 “the neighbouring parts, that the greatest Dimi-
 “nution of the Heat of the Sun dos fall. From
 “whence it appears that the said Diminution can-
 “not be very great: Especially, in our present In-
 “quiry, not the whole Diminution of the Sun’s
 “Heat being to be accounted for; but the Di-
 “minution or Difference only from what the
 “Heat of the Sun is, when as high as in r .

*The Result of
 it.*

However the Number 3.58 being certainly
 too small, and the Number 4.47 certainly too
 great, to express the whole Heat upon the Slo-
 ping Wall, it cannot but be pretty near 4 times
 as great as the Heat upon the perpendicular Wall:
 the middle Number between those being 4.02.

This Method, which is clear and easie, is suf-
 ficiently exact for our purpose: and it can be
 easily transfered to other Latitudes, and to
 the Cases where the Wall is more or less slo-
 ping: not to mention those where the Wall
 has indifferently any other Exposition.

*Other Ex-
 amples to the
 same purpose
 for the Lat-
 itudes of 51½;*

Thus if we leave the Latitude of $52\frac{1}{2}$ De-
 grees, which is about the middle of *England* and
Holland, and make the like Calculations for the
 Latitude of *London*, “ LT will become 2204;
 “ TV will remain 8410. The Space MTL will
 “be to the Space MTV as 2204 to 8410; or
 “as 1 to 3.82. The Arc $\tau\mu$ will be $47^{\circ}38'$.
 “ $\tau\lambda$ is of 60 Degrees, as it was before. Now

“as

“as $47^{\circ}38'$ to 60° , so is 8410 to 10593,
 “which comes for the Space ITV . And divi-
 ding 10593 by 2204 the Quotient is 4.81;
 which is too great to express the Heat upon
 the Sloping Wall, as 3.82 is too little. The
 middle Number is 4.31, which was only 4.02
 before. So here the Disproportion is conside-
 rably greater, between the Heat for the Sloping
 and the perpendicular Wall. On the Equinoctial
 Day the Heats are as 1000 to 614.

In the Latitude of 45 Degrees “ TL becomes *and 45 De-
 grees.*
 “1344, which gives MTL to MTV as 1 to 6.26.
 So the Heat is already 6.4 times greater for the
 Sloping than the Perpendicular Wall: besides the
 Addition of Heat MVI , which is very considera-
 ble. For the whole Space ITV is about 8.3 times
 bigger than MTL . The Middle between those
 two Numbers is 7.1. On the Equinoctial Day
 the Heat is exactly doubled. The immediate
 Action of the Sun upon the Walls, without a-
 ny regard to the Heat reflected from the Ground,
 or occasioned by the Warmth of the Air, does
 not become equal for both the Perpendicular
 and Sloping Wall, till the Sun has got a consi-
 derable South Latitude.

By this it appears that our Walls are not
 only good for the Climates of cold Coun-
 tries, but that they will have the greatest Ef-
 fect farther from the Poles. In England and Hol-
 land *Sloping
 Walls are
 more necessa-
 ry in col-
 der Coun-
 tries; but
 the Increase
 of Heat they
 give is great-
 er in warmer
 land Climates.*

land, and all the North, they are almost necessary; because without them Fruits can hardly be very good. In France &c, they cannot fail of producing most excellent Fruits, of the Kinds that require a great deal of Heat, they being able there to outdo so much ordinary South Walls; than which confessedly there is among perpendicular Walls no hotter Exposition.

*Sloping
South Wall
passing thro
the Pole less
hot, in the
Solstice, than
the South
Wall passing
thro the low-
er point of
the Polar
Circle.*

Hitherto I have not compared Sloping and Perpendicular South Walls to the best Advantage of the former. For in our first Latitude of $52\frac{1}{2}$ if the Sloping Wall was at Noon exposed directly to the Sun in the Tropick, there would already be above $4\frac{1}{2}$ times the Heat "from the
" Comparison of the two opposite Parabolas. Besides that Addition I have so often mentioned, which would make the Heat about $6\frac{1}{2}$ times greater, were it not for the Interposition of the Atmosphere. The middle Number is $5\frac{1}{2}$ or thereabouts. In the Equinox the Proportion of Heats would be found as 1000 to 748. So then a little loss of Heat near the Equinox is here very largely made up about the Solstice. And this may invite (instead of giving to the South Walls the same Elevation, as the Pole has above the Horizon) to give them rather a smaller Elevation by 15 or 20 Degrées.

If

If you desire a more accurate Method of comparing the Sun's Heat upon two different Walls, but with neglecting the Effects of the Air, you will have it in the Solution of the following Probleme; " which depends upon the Quadrature of the Center of Gravity of the Line of Sines.

A more accurate Method of comparing the Sun's Heat upon two plane Walls in any Situation. This Method de-

" The Latitude being given, for Instance that of London, to find for a given Day, suppose that of the Summer Solstice, the Heat of the Sun upon any Plane Wall whatsoever; suppose a Sloping Wall that lies, for Instance, North-East and North-West, and has an Elevation of 48 Degrees upon the Horizon, going obliquely from the North-East Point towards the North. The great variety of Cases, into which this Problem may be branched, obliges me thus to fix my Discourse, by applying it, in a great measure, to a particular Example.

pends upon the Quadrature and Center of Gravity of the Line of Sines and its Segments :

" Conceive, in the fifth Figure, the Sphere *Fig. V.*
 " $POBDA\beta G$ AP, projected about the Center c,
 " for an Eye placed at an infinite Distance, in
 " the common Section of the Planes of the Sloping Wall, and of the Equator, or its Parallels. Let $\alpha x CNKA$ be the Plane of the Sloping Wall; $\beta x CE\xi B$ the Plane of the Equator; P the Pole of the World; $DEZKH\zeta x D$
 " the Horizon; $OTZN\zeta G$ the Tropick or Parallel;

Fig. VI.

" let ; n the common Section of its Plane, with
 " the Plane of the Wall, whether this Section fall
 " within or without the Sphere ; z , ζ the two
 " Intersections of the Tropick or Parallel with the
 " Horizon, if they meet each other. In the Tri-
 " angle CKE the side EK being given, as here of
 " 45 Degrees, and the Angle E being of 38 $\frac{1}{2}$,
 " and the Angle K of 48 Degrees, you will ea-
 " sily find the side EC and the Angle C . Take
 " upon the Equator CX equal to the Complement
 " of CE ; and thro' the Point x conceive the Me-
 " ridian $XHPT\xi X$. In the Rectangular Trian-
 " gle EBD find BD ; and so draw thro' the Point
 " E the Horizon $DEZKH\xi XD$, cutting, as I said,
 " if it lights so, the Tropick or Parallel OG
 " in the Points Z , ζ ; and draw the Indefinite
 " Lines zy , ζv perpendicular to OG . Take the
 " Radius of the Sphere for Unity; and make ov ,
 " perpendicular to OG , equal to the Square of
 " the Sine of the Arc OA . From the Point n
 " as Vertex draw thro' the Point v the Parabo-
 " la $nyvv$, making no to be a Tangent at the
 " Vertex. Transfer as much of the Cylindrical
 " Surface $nvNON$ into the sixth Figure, (where
 " it is opened, and the Parallel or Tropick be-
 " comes a straight Line) as there is of it that is
 " seen from the Wall. And thus having drawn
 " from the Points Z , ζ duly transfered, if they
 " be seen by the Sloping Wall, the Ordinates zy ,
 " ζv ,

“ ζ , the Space between them $ZYVNZ$, after it
 “ is increased in the proportion of the Circum-
 “ ference or Radius of the Tropick or Parallel
 “ to the Circumference or Radius of the Equa-
 “ tor, will give you the measure of the Heat up-
 “ on the Sloping Wall. But this is with ne-
 “ glecting the Effects of the Atmosphere. Now
 “ that Space, or a Solid proportional to it, is
 “ found by having the Quadrature and Cen-
 “ ter of Gravity of the Line of Sines, and of its
 “ Segments; all which are already known. The
 “ Truth of this Assertion is obvious without any
 “ farther Demonstration of it; and will appear to
 “ agree with the following Construction, which
 “ also dos solve the Problem.

“ To the Circle ONG , Fig. V. conceive the Fig. V.
 “ correspondent Line of Sines $AOYBZGA$ Fig. VII. Fig. VII.
 “ In which the Axis AB is equal to the Semi-cir-
 “ cumference, and the other Axis OG is equal to
 “ the Diameter of the Parallel or Tropick. Thrô
 “ the Point N duly transfered upon OG , to wit,
 “ with making GN , GN equal in both Figures,
 “ draw the Parallel NNN to the Axis AB , till it
 “ meets in N , N with the Curve AOB continued
 “ for that purpose as far as is necessary. And
 “ having also duly trasfered the Point Z , by ta-
 “ king the Line NZ equal to the Arc NZ , and ha-
 “ ving drawn ZY perpendicular to NNN , and
 “ meeting with the Line of Sines AOB in Y , up-
 “ on

" on NNZ as the Edge, and $ZYOANZ$ as Basis,
 " erect a Semi-quadrantal Ungula; and find its
 " Solidity or bigness, by those Rules Dr. Wallis
 " has publisht in his Mechanicks; where he has
 " given the Quadrature and the Center of Gra-
 " vity of the Line of Sines and its Segments.
 " Then depress that Ungula, or make it smaller,
 " in the Proportion of the Square of NO to the
 " Square of the Sine of the Arc OA . When the
 " Solid of this new Ungula is found, correct it
 " again, increasing it in the Proportion of the Cir-
 " cumference or Radius of the Tropick or Pa-
 " rallel to the Circumference or Radius of the
 " Equator. The new resulting Solid will be
 " proportional to the Heat of the Sun upon the
 " Sloping Wall, if we neglect the Effects of the
 " Air.

" After the same way might be found the
 Fig. IV. " Solid expressing the Heat $MTMLM$ of the IV.
 " Figure, upon a perpendicular South Wall; for
 and is gene- " the Solution is general.

and in some " But if the Cylindrical Surface $MTMLM$ be
 few Cases " also duly transfered into the VI. Figure, as
 Fig. VI. " you see it done; and upon the Basis MTM ,
 capable of a " when it falls intire between the Points N, N ,
 very easie " you draw the Curve Line MAM , whose Or-
 Approxima- " dinates upon MM are every where proportional
 tion; " to the correspondent Ordinates of the Curve
 " MLM , and whose swelling comes just to touch
 " the

“ the Curve nvN , the Heats expressed by the
 “ Surfaces $mLmM, mAMM$ will be as TL to TA , not-
 “ withstanding the Effects of the Air. Which notwithstand-
 ing the Ef-
 fects of the
 Air.
 “ consideration may be of some Use, where the
 “ bigness of the remaining part is but small, and
 “ to be guessed at, as we did heretofore, by
 “ some easie Approximation. But this by the
 “ by.

This Solution gives, as a Corollary, the Me- A Corollary
 for finding
 the Heat of
 the Sun up-
 on a Plane,
 parallel to the
 Horizon.
 thod of measuring the Heat of the Sun upon the
 Horizon, any Day in the Year, for any propo-
 sed Climate; tho it remains yet to account for
 the Diminution of Heat arising from the Atmo-
 sphere.

I do not expect that the whole crowd of Ge-
 ometers will see that our Constructions carry
 with themselves the Strength and Evidence of a
 Demonstration. But this Discourse being intend-
 ed to be, in a great measure, popular, I am loth
 to fill it with a long Digression, only to make
 our Proofs evident to a greater number of Mathe-
 maticians. Let it be enough that some of them
 may perceive that we have advanced here nothing
 but what is exactly true.

Having calculated a Table of the Sun's Heat A Table
 shewing the
 Sun's Heat
 upon a Plane
 for each De-
 gree of the
 Sun's Ele-
 vation upon
 upon a Plane, for each Degree of the Sun's Ele-
 vation upon the said Plane, I thought it might
 be acceptable to some if I transcribed it here. In
 ‘ this Table the Heats to an Elevation and to its
 H ‘ Com- it.

FRUIT-WALLS

Complement make always the same Sum: Which depends upon the Squares of the Sides being, in a Rectangular Triangle, equal to the Square of the Hypotenuse.

The Sun's Elevation upon a Plane.		The Sun's Heat upon a Plane.		The Sun's Elevation upon a Plane.		The Sun's Heat upon a Plane.	
Deg.	Parts.	Deg.	Parts.	Deg.	Parts.	Deg.	Parts.
1	3	31	2653	61	7650		
2	12	32	2808	62	7796		
3	27	33	2966	63	7939		
4	49	34	3127	64	8078		
5	76	35	3290	65	8214		
6	109	36	3455	66	8346		
7	149	37	3622	67	8473		
8	194	38	3790	68	8597		
9	245	39	3960	69	8716		
10	302	40	4132	70	8830		
11	364	41	4304	71	8940		
12	432	42	4477	72	9045		
13	506	43	4651	73	9145		
14	585	44	4825	74	9240		
15	670	45	5000	75	9330		
16	760	46	5175	76	9415		
17	855	47	5349	77	9494		
18	955	48	5523	78	9568		
19	1060	49	5696	79	9636		
20	1170	50	5868	80	9698		
21	1284	51	6040	81	9755		
22	1403	52	6210	82	9806		
23	1527	53	6378	83	9851		
24	1654	54	6545	84	9891		
25	1786	55	6710	85	9924		
26	1922	56	6873	86	9951		
27	2061	57	7034	87	9973		
28	2204	58	7192	88	9988		
29	2350	59	7347	89	9997		
30	2500	60	7500	90	10000		
Degrees.	Squares of their Sines.	Degrees.	Squares of their Sines.	Degrees.	Squares of their Sines.	Degrees.	Squares of their Sines.

If

‘If the Sun’s Altitude be given, and you ex-
‘pose to its Rays a Plane, with more or less O-
‘bliquity; the Sun’s Heat upon it will be, in
‘any Obliquity, as the Table shews. But if the
‘Sun’s Altitude be supposed to change, the Ef-
‘fects of the Atmosphere ought also to come un-
‘der consideration. I need not say that I make
‘no allowance for the Sun’s apparent Diameter
‘being of a pretty great bigness, and not insen-
‘sible like the Stars.

*The Use of
the Table.*

As to the Diminution of the Sun’s Heat, oc-
‘casion’d by the Interposition of a greater or less
‘depth of Air, it is certainly very great. We
‘cannot bear the Sight of the Sun when it is some-
‘thing high; much less if it was in the very Zenith.
‘But it is no hard matter to bear it, when the Sun
‘is within three or four Degrees of the Horizon.
‘It is not easie to find by bare Study the Laws
‘of that Diminution; ‘not only because of the
‘different Density and continual Refraction of the
‘Air, at several Heights from the Center of the
‘Earth; but especially because of that wonderful
‘Propriety of Light, that makes it go thro’, and a-
‘mong Terrestrial Bodies, under a certain and
‘determinate Degree of smallness, depending up-
‘on their Density, without being affected at
‘all in its Passage. However I see how that
‘Diminution might be found, by some Experi-
‘ments made with a large burning Speculum con-

*The Dimi-
nution of
Heat occasi-
oned by the
Air is con-
siderable;*

*but hardly to
be found by
Meditation;
and why.*

*A Method
for finding it
by some Ex-
periments
with a burn-
ing Specu-
lum.*

stantly turned to the Sun for a whole Summer-Day, and with a Thermometer kept by it always at the same degree of Heat.

The middle of the Speculum must be shaded by a round Plate, supported exactly over against it. In the Shade of this Plate, and not far from the Focus of the Speculum, the Thermometer, which ought to be but small, must be duly fastened. The Speculum ought to have a graduated Circle about it. And by the different opening of an Arched Ruler, that is to move about the Center of the Speculum, and to be every where pretty near its Surface, it ought to have an Opaque Vail spread, more or less, before it: So that a greater or smaller Sectour be uncovered, according as the strength of the Sun's Heat requires. That Heat will be reciprocal to the Arc or Sectour uncovered. So then keeping, in one of the longest Days, a Table of the Quantity of this Arc, for the several Minutes, or other Intervals of Time, of which the Day is composed, one may easily gather the Proportion of the Sun's Heat it-self, such as is transmitted thro' the Atmosphere.

A Table giving the Length of a Beam of Light in the Air, supposing the Height of the Atmosphere given, &c.

The following Table, which is very short and easie to make, or, instead of it, some other Table made upon the like Principles, might help us also to guess a little, in so dark an Inquiry. This Table gives, upon some

some Suppositions, the Length of the Way of the Sun-Beams thro' the Air, to every apparent Altitude of the Sun.

Apparent Altitude of the Sun.		Length of the Way of the Sun-Beams thro' the Air.
Deg.	Min.	Parts.
0.	0	20.
0.	18	19.
0.	37	18.
0.	57	17.
1.	18	16.
1.	41	15.
2.	6	14.
2.	33½	13.
3.	4	12.
3.	39	11.
4.	19	10.
5.	6	9.
6.	3	8.
7.	13	7.
8.	45	6.
10.	51	5.
13.	55	4.
19.	4	3.
29.	45	2.
31.	31	1.9
33.	32	1.8
35.	51	1.7
38.	30	1.6
31.	39	1.5
45.	26	1.4
50.	9	1.3
56.	21	1.2
65.	19	1.1
90.	0	1.

"Let $2r$ be the Diameter of the Earth, equal, for instance, to 400 Parts : a the Perpendicular Height of the Air that is able to obstruct sensibly the Light of the Sun : this I suppose, for an Example, equal to 1 Part. Let the Indeterminate q be the Length of the Way of the Sun-Beams thro' that Air : the Sine of the Sun's Apparent Altitude to the Radius r : and neglect the Effects of Refraction. In these Suppositions you will find $\frac{ss + 2ar - qq}{2q} = s$. Which Equation is the Ground, upon which the Table was calculated. And if you give any other Value to the Quantity

“Quantity a , you will easily make such another
 “Table, at your pleasure, by the help of the
 “same Equation.

‘If we suppose the Air every where of an
 ‘Uniform Density; and its Perpendicular Height
 ‘given; which will be easily determined in that
 ‘Supposition: and the whole Refraction of the
 ‘Rays of Light to be, at their coming into the
 ‘Atmosphere: and that the same Quantity of
 ‘Light penetrates into the Air, whether it comes
 ‘with more, or with less Obliquity; it will be
 ‘easie to make a Table shewing the loss of Light
 ‘occasioned by the Air, for any given Apparent
 ‘Altitude of the Sun. And this may, perhaps,
 ‘serve well enough for Use.

Fig. VIII.

“From Experience find the Proportion of
 “Light, suppose as a to b , for any two Appa-
 “rent Altitudes of the Sun; suppose 62 and 30
 “Degrees. Let the Length of the Rays in the
 “Air for those Apparent Altitudes be as n to m .
 “Draw, in the eighth Figure, the Assymptote OAB ,
 “of an Indefinite Length. Take in it OB equal
 “to m ; OA equal to n ; and AB will be equal to
 “ $m-n$. Draw to the Assymptote the perpendicu-
 “lar Lines AD , BC , equal respectively to a and b .
 “Thro the Points C and D draw the Logarith-
 “mic Line $FCDQ$: and draw the Ordinate OQ .
 “If you suppose OQ for the whole Light, that
 “enters the Atmosphere; and, upon the Assym-
 “ptote,

"ptore, you take, from the Point o, the Line
 "oe equal to the Length of the Rays of Light
 "in the Air; the correspondent Ordinate ef
 "will give the Quantity of Light remaining, af-
 "ter the Passage thro so much Air, as the Length
 "of the Rays dos expose: And a Table of its
 "Diminution will easily be calculated. The
 "Ground, I proceed upon, is that if two Solid
 "Rays of Light pass, thro a given Thicknes of
 "Air equally dense, they will lose of their Quan-
 "tity, or Strength, in the same Proportion, as
 "they have to one another. By the like Me-
 "thod you may find how much more Light there
 "is, at any time, near the Surface of a Calm
 "Water, than in any given Depth. ' And this
 'is what we had to say of the Diminution of
 'Heat, occasioned by the Rays of Light crossing
 'the Atmosphere. Let us now take our leave
 of these Mathematical Speculations, and go on
 to consider what Advantage we can make of
 Movable Walls.

As there are some Countries, or some sorts
 of Fruits, for which the best is not always the
 hottest Exposition; so there are some other Coun-
 tries, or some other sorts of Fruits, for which we
 cannot well procure too much Heat. But it will
 be a hard matter to outdo much the South Walls
 of our second, or third, or eleventh Figure; of
 which last I shall speak hereafter; unless it be
 per-

Of Movable Walls, in order to receive the Light of the Sun almost perpendicularly for the whole Day. perhaps by a Movable Wall. I shall not mention here the placing some Earth, and having a Sloping Wall built, all along in a kind of Boat; or otherwise built, in any other sort of floating Vessel; as suppose a round one. Tho' with the turning of the Vessel, so as to follow the Sun; and making it, and the Wall at the same time, lean more or less, one might be sure to enjoy almost all the Sun's Heat.

Description of an Engine for that purpose.

I will only describe a kind of movable Box, which having an Inclined Brick Wall fastened to it, will, without any Water, which both is difficult to procure, and rots Vessels too easily, have the same advantage of being constantly turned towards the Sun; and may, in Winter time, be laid up in an Orange House. In the IX and X Figures *A B* is a strong Post fastened upright in the Ground; whole upper end *B* is shaped into an Hemisphere, or rather into a Part of a Sphere, yet something bigger. Upon *B* there rests a strong piece of Oak, *c c*; in the middle of which there is a concave Place, so made as to fit the Figure of *B*, and to leave the liberty of turning and inclining the Box several Degrees to and fro. The concave Surface will be great enough, if it contains the half of the Surface of an Hemisphere. *D* is the Box it self; which is somewhat long, and so shaped that the Sun may shine pretty fully upon the foreside of it. To the two sides of

of the Box, and to the Piece *c c*, are fastened
 two inclined Pieces of Timber *e f*, *e f*, almost
 parallel to one another ; and upon these, close
 by the Box, another pretty long horizontal
 Piece of Timber *g g*. The remaining Pieces
g f, *g f*, *g f*, *g f*, *f f*, *e g*, *e g*, *e e*, are so disposed as
 to give much Strength to the whole Frame. Up-
 on the Part *g f f g* I place a Floor of Boards,
 and the Piece *g g* jets out some two or four In-
 ches, from that Floor. I use both the Piece
g g, and the Floor of Boards, for the Founda-
 tion of my inclined Brick Wall ; to which I
 give a thickness equal to once or twice the thick-
 ness of a Brick, according to the Weight as I
 desire it should have. Under the Box are yet
 two strong parallel Pieces of Timber *h h*, run-
 ning on each side close by the Post *a b*; and
 made firm together, at both their Ends, by two
 cross Pieces. From the back End of *h h* there
 rises several Pieces *h k*, *h i*; which being fasten-
 ed to the Pieces *e f*, some near the Middle, some
 at or near the upper End of the Floor or Frame,
 help to bear it up. In the Pieces *h h* there might
 be some holes, at proper distances from each o-
 ther, for two Iron Pegs, one of each side the
 Post *a b*, to keep, at your pleasure, the whole
 Box in a proper Elevation. But this might be
 done more conveniently with Cords. For from
 the Ends *e, e*; *f, f*; *g, g*; *h, h*, you might have some

I

Cords

' Cords fastened to some pretty great Weights of
 ' Metal or Stone, or else to some Buckles, to
 ' keep the whole Engine firm in any position.
 ' In the making of it it must be so proportioned,
 ' in all its Parts, that the Center of Gravity may
 ' fall under B, but withal near it. And so it will
 ' be proper that the Floor be not exactly flat,
 ' but convex. The Addition of some movable
 ' Weight like P might also help to alter the Cen-
 ' ter of Gravity, and to manage the Engine more
 ' easily. And it is to be observed, that the far-
 ' ther C C is from the Box, the wider you may
 ' make it at bottom. Such an Engine as this will
 easily be defended from Ants and other creeping
 Insects. ' About the Floor G F F G one might have
 ' a kind of plain Border, with an Inclination to
 ' the Floor, of about 45 Degrees every where:
 ' which Border, by its Reflexion, would much
 ' increase the Heat, and make it closer; giving
 ' besides some Shelter from Winds: And upon it
 ' one might spread a Net, to keep off the Birds
 ' and Flys.

If, by an easie change, you should desire to
 have two Boxes and two Trees, in one single En-
 gine, the Boxes being something distant from
 each other, there would be room for the Post A B
 between them; and you might make them as
 broad as you would at Bottom; and fix the
 bearing Place much lower, if you thought it

con-

convenient so. Instead of Bricks the Floor might perhaps be covered with Lead, either painted dark or black, or not painted at all. But I am apt to think it would give, in some Climates not far from this, and at some Seasons in the Year, too great a Heat for Vines, and such other tender Trees.

One advantage of Movable Walls is that they may, at any time, be turned from Storms, and from cold or blasting Winds; and take in as much, or as little, of the Sun-shine, as one pleases. They might besides, when the Sun is strong, and the Fruit grown large, be sometimes presented side ways to the Sun, that it may shine fully upon the Sides of the Fruits; and give them also that fine Colour which becomes the whole Fruit so well. But after all these Walls may better serve the turn of some Curious Body, than the Publick. They will be good particularly for Melons, Vines, Figs &c, and for raising early most sorts of Fruits.

Advantage of movable Walls against storms and winds.

Their Use for early Fruits.

As to our former Sloping Walls, it remains yet to order them so that we may not be troubled with the Rain, they are apt to bring in abundance to the Root of our Trees. But this certainly can be no fault in a dry Season, or light Ground, or Easterly Wall, or hot Countrey; especially considering the great force of the Sun upon our Terrasses, which will quick-

Of the Rain falling upon Sloping Walls.

ly dry the Ground. In other places, besides what may be done, by receiving and turning off the Rain, the Walk might be made as you see in

Fig. XI. the XIth Figure ; where it is pretty deep in the middle of it. is the Slope of the South

*Terrasses so
shaped as to
give some
more Ad-
vantages in
reference to
Rain and
Heat.*

Wall ; A M the Cultivated Ground, some three, four, or five Foot broad : M N another thin Sloping Wall, parallel to B A, and some three or four Foot high : N O the Walk, or Path ; which may be five or six Foot broad, and paved, if you think fit. O P, P E, E G are the correspondent Sloping North Walls and Cultivated Ground. The great Depth of N O will keep the Grounds A M N, E P O pretty dry : and the Path N O may be made falling, in order to bring the Water to some Drains, where it may be lost. In an extraordinary wet Weather, one might use some slight Boards, like Q R, and place them so, near the Foot of the Sloping Wall, that they might receive the Rain at their upper end, in order to convey it to the bottom N O. For this purpose it is proper that there be a very small jetting out in the Wall, to which the Boards may be closely applied. Or rather one might, at first, fix in the Wall a long and narrow piece of beaten Lead, which necessarily receiving the Rain, would easily bring it to the upper Surface of the Boards, or to some Gutters placed along the Wall, which would

' would be much convenienter than the Boards ;
 ' and would easily convey the Water to some o-
 ' ther Gutters that should make it fall upon the
 ' Bottom NO. The Slope MN, receiving so
 ' directly the Sun-shine upon it, will help ve-
 ' ry much to heat the Ground NMA ; and by
 ' consequence will, in some measure, forward
 ' Vegetation. The Bottom NO, which is to serve
 ' for a Path or Walk, must be raising near the
 ' middle in a round Figure, to keep it dry there.
 The two Terrasses being farther from one ano-
 ther, than in the second or third Figure, the
 Heat will accordingly be less close.

Now we have begun to propose, for our Ter-
 rasses, a Shape something different from that ex-
 cellent one, in the second and third Figure ; we
 may farther observe that there would perhaps be
 some small Advantage to shape our cultivated
 Ground so as to have it better exposed to the Sun,
 and grow warmer. ' We might, for Instance,
 ' let the Section of our Walk, in the eleventh
 ' Figure, be according to the Lines BRMNOTEG ;
 ' and order matters so, as not to be troubled
 ' with the Rain, especially in the Ridge E. And
 ' by these means we should also get a Sloping
 ' Wall OT, of a tolerable bigness, and very
 ' well sheltered, but ill placed, and of an indif-
 ' ferent Exposition.

You

Idea of a paved sloping Ground upon a Hill, to be used instead of Terrasses with Sloping Walls.

You may remember how, speaking to the first Figure, I did chuse, in the side of a narrow Vale, a pretty steep Hill well exposed; which I did shape into several Terrasses, one above another. I don't know but that, keeping to the like Idea, it may succeed pretty well, especially about 45 Degrees Latitude, to chuse that Hill very steep, to take it almost as Nature does give it us, and to pave it all over with Brick laid flat, except some Holes of an Oval Figure, about six or seven Foot long, and about four Foot broad. These Holes are each to receive at the Top of them a Tree, whose Branches must be made to spread upon the paving of Bricks. The greatest Diameter of the Ovals ought to be horizontal. They must be disposed with as much regularity as possible. They will look handsomer, and will be more equally divided, and lie more convenient for the spreading of the Tree, and to receive all the Rain, if they be Checker-wise; as you see them in the twelfth Figure. But they will lie something more conveniently to turn off the Rain, if they be above one another. However it seems there is no great danger to be feared, from too much Rain, in a Hill so well exposed to the Sun; and where an extraordinary quantity of Rain will not fail to find its way down, or will ever be easily turned off. The uncovered

Fig. XII.

ed Earth must be dug as often, as it is convenient. The Bricks will grow very hot, by the Sun shining so fully upon them : And, for ought I know, they may hinder the too great and useless Dissipation of the Spirits of the Earth, that secret and precious Fire of Nature, not only by preventing the growth of Grass, but also by intercepting their way, and making them come out, in greater abundance, at the place where the Trees and their Roots are. The good Earth must have been gathered to a sufficient Depth about the Ovals. It is easie to order it so that either all the Rain shall run into the Ovals, or most of it run down at the sides of them, according as your Climate or the Season requires. As to the Charge, both in Bricks and Mortar and Day-labour, it will come, for each Tree, to much less than half the correspondent Charge, in building of a perpendicular Wall ; tho' we should suppose this to have Trees on both sides.

Since I began this Treatise, I have often inquired whether our Sloping Walls had been used any where : And particularly I have endeavoured to find, in Monsieur la Quintinye's Book, what he says that may relate to this matter. It is very plain that they are in no common use, if used at all, in these Northern Climates, where they are most wanted. And probably

It will prevent the dissipation of the Spirits of the Earth.

What the Author finds said by others, particularly by Monsieur la Quintinye, that may have some relation to Sloping Walls.

bably they have had no occasion to think of them in hotter Climates, where, for the most part, Heat is as much feared, as here it is desired. But I would fain have known whether ever they had been designedly built, on purpose to enjoy the Sun longer, and to increase its Heat.

* Tom. I. Monsieur la Quintinye speaks * of some Sloping Grounds, which he calls *des Ados*. * These, * he says, are an Earth raised up, with a Slope, * along a well exposed Wall, in order to sow * upon it, in Winter time and in the Spring, * some Plants, that are designed to be more * forward, than in the open Ground. So Pease * and Beans are sown, and Artichokes, Vines, * Raspberries &c, are planted upon an *Ados*; the * Reflexion of the Sun, probably from the Wall * above, and from the Ground before, heating * these Slopes, as if they were real Walls. What I find said of them, in the rest of the Work, is much to the same purpose.

* Tom. I.
p. 20. Edition of Amsterdam,
1692.
An Account of what Monsieur la Quintinye calls des Ados.

By this contrivance, the Origine of which I do not at present inquire into, one does considerably increase the Heat, at all times in the Year; and I do not see that one can out-do it much in Winter or Autumn. But, in the Spring and Summer, the Wall hides the Sun from the Slope for some time; which perhaps the Reflexion from the said Wall is not a sufficient

cient recompence for. To which must be added, that the Heat is perhaps better, being divided to a greater part of the Day, than crowded together about Noon. However by this Disposition of the Wall the Heat is made closer.

In another Place * he dos mend the hanging of the Ground, in a large Garden, but without admiring at all the Remedy, by dividing it into several Parts, of different heights, and making each of them level, and parting them, either by some little Walls, or only by some Slopes of Earth closely beaten together. And being satisfied, as he has it somewhere else, that there is no place, in a Garden, but what may be of some use ; he says, * That these little Walls may * serve for several things he mentions : and that * the little Slopes will not be useles neither ; but * on the contrary, when they are exposed to the * South or East, they may either be used to raise * at first some early Plants, for the Spring ; as * Winter Lettuce, Pease, Beans, Strawberries, * Artichokes &c ; and after the Spring they * may serve to raise some Seeds of Purslain, Basil &c : or else, if there be a great quantity of * those Slopes well exposed, a part of them may * be imployed for good and all to bring forth * good Grapes and other Fruits ; as it has been * done in the King of France's Fruit or Kitchen * Garden, in certain Slopes purposely made for * that use.

* Pag. 92.
And of his
Slopes of
Earth exposed to the
South or East,
and purposely
made for
Fruit.

K

I

Reflexion
upon this
Contrivance;

which is here
compared
with Sloping
Walls.

I guess, by these Passages, that the worthy Author, who is ever very particular and full in what he writes, thò he says no more in this matter, used these Slopes no otherwise than as Grounds, and as they do chuse some Hills well exposed for their Vines, or even for their Gardens. But thò this be something a-kin to the main Idea I follow, in this Discourse, and a Confirmation of it, yet I believe there remain some considerable differences, between what Monsieur *La Quintinye* has writ, and what I propose. The Gardens of his making may justifie whether or no he had left any room for our Meditations. Which would indeed be only a fuller Explication of his Thoughts, if he had covered his Slopes with Bricks or Stones; and had made his Trees to grow against them obliquely to the Ground; and had used them in any Exposition rather than perpendicular Walls; and had made them sometimes more, sometimes less Sloping; and had defended them, as I do, against Winds; and had likewise procured the closeness of Air, with no loss of either Sun or Rain, for the six or seven hottest Months, from Equinox to Equinox: Not to mention some other Improvements you will find in this Treatise. However those Ados of Earth have a peculiar advantage for all Herbs; and particularly for those early Plants, that are to be gathered in *February, March, or April.*

To

To this I might add the Account Monsieur *La Quintinye* gives of Square or Rectangular Gardens; where he explains how the Sun never shines upon more than two Walls at once; and in some Moments upon one only; without ever shining upon two opposite Walls together. But near the Summer Solstice one might see, for a good while together about Noon, the Sun to shine at once pretty full upon the four Walls of a Rectangular Garden built after our way: and seldom, in the rest of the Day, to shine upon less than three Walls, except the Sun be very low.

Part I.

pag. 206.

Our Gardens, tho' Square, may at once enjoy the Sun upon their four Walls.

There is in Monsieur *La Quintinye's* Book a Ground Plat of the Kitchen Garden, or Fruit Garden, of *Versailles*. Tho' there be in that Garden a high and very long Terrasse, with Trees on both sides against it, yet the Ground Plat shews that the Walls of it are perpendicular. So this Terrasse having at once the disadvantages of being more chargeable, and less solid or lasting, and worse for Vegetation than a Terrasse with Sloping Walls would be, I cannot but conclude also from thence that Monsieur *La Quintinye* knew no other Walls than perpendicular ones. As to the Beauty, I acknowledge indeed our Sloping Walls not to be altogether so handsome as the others are: And yet I do not doubt but the Eye will soon be accustomed to them; especial-

In Monsieur La Quintinye's Ground Plat of the French King's Garden no foot-step found of Sloping Walls.

To what degree they may be unpleasant to the Eye.

ly when it may look upon them more as Terrasses, than as Walls ; so that their leaning may not seem to threaten a fall.

*Objection
from Mon-
sieur la Quintinye's En-
glish Trans-
lation sol-
ved.*

In the English Translation of Monsieur La Quintinye, I find a place, that seems peremptorily to condemn our Sloping Walls. It is near the end of the fifth Chapter of the third Part of the first Volume. There you may read, * By * all I have newly said, about the Height of * Walls, it appears that I have little value for * those leaning Walls, to pretend to make them * Fruit Walls for Pears, Peaches, Apricocks &c ; * but they may serve for something else. And in the Margin you find also writ, * Leaning * Walls not proper. But the Sense, in the French Original, is that such Walls as are only breast high (*des Murs d'appui*) are not good for Fruit. Neither was the Author speaking of Sloping Walls before, but of the Height of perpendicular Walls.

*Account of
an Amphitheater with
Sloping
Walls.*

I have also heard of a large round Pit, like an Amphitheater, built here in England with Sloping Walls all about it. The Ground in the middle was, as they said, several Yards Diameter, perhaps about 50 or 100 or more. And upon all that Ground there grew Vines, both sheltered from Winds, and cherished with a closer Heat, than they could have in the open Air.

A Person of Quality has tryed about, 53 Degrees Latitude, in the present Year 1697, to increase the Sun's Heat upon his Melons, by some pretty large Convex Glasses. These being placed, between the Sun and the Melons, did gather the Rays in a pretty small Focus each. And we have been told, to our admiration, that the Melons thus helpt have been tolerably good, and much better than others that did grow in the Neighbourhood, which were generally bad ones. As if it were enough to heat any one part of the Fruit, to make the Effects of it to spread over the whole. But I hear also that the like Tryals having been made upon several Fruits, in other places, have had no other success than the giving them some unkindly precocity, leaving withal to them a harsh and unpleasant taste.

And of some Melons, and other Fruits, heated with Convex Glasses.

In some places, they make a Vine to grow as high as the Roof of some ordinary Building; and there to spread its Branches over the whole Roof. In other places, they make the Vines to grow first as high as the top of a Garden Wall; and there to part into two Branches, running on each side, for 25 or 30 Foot together, upon the small Coping of Bricks, they do sometimes end their Garden Walls withal. Tho I have been told that, with the first of these two ways, they have had some good Grapes in England; yet I find,

The fault of Vines that are commonly made to grow against a Roof, or the Coping of a Wall.

find, in both of them, this capital fault, that the Roots having work enough to feed so long a Stock, and to garnish such a large extent with Leaves, and a thousand other little useless Shoots, there can remain no strength in the Sap, for the production of Grapes; unless perhaps they be some few and ill favoured ones.

*Judgement
of those and
all other such
Trials, in or-
der to make
the most of
the Sun's
Heat.*

All these and the like Trials were indeavours towards what is here more fully stated: for I do not doubt but a great deal more besides has been attempted, in many places, in order to make the most of the Sun's Heat. Whether I have done any thing more towards it than others, let either Experience justify, or those determine, that are able to understand the Mathematical part of this Discourse. But after all I acknowledge readily that our Invention required but an ordinary Capacity, to light upon it; and even but an indifferent Skill in Geometry, to examine and establish it upon its true Principles.

*Caution a-
gainst too
much Heat
Sloping
Walls are
like to pro-
cure.*

I must here repeat again and again, that I have, in this Discourse, indeavoured to increase the Sun's Heat to an extraordinary degree: and this, I hope, I have found how to do effectually. But it is easie in hot Climates, and in some light and dry Grounds, and in the governing of tender Plants, to err by an excess of Heat. If any body should fall into that Errour, it must be by his own fault. He may take as much and

as

as little, as he pleases, of that degree of Heat, which is to be had by our Sloping Walls. Tho' accommodating my self to the Climate of *England*, where too much Heat is hardly to be feared, I may perhaps have sometimes spoke, as if one were always to take the most. However a pretty good Remedy, against too much Heat, is to keep constantly the Ground sufficiently watered: So that the Trees being conveniently full of moisture, their Fruits may be so much the farther from being scorched and dryed up. And here I may observe by the by, that if our Terrasses be so broad as to have, at the top of them, a little Rivulet, or Aqueduct, it will be very easie from thence to water them on both sides. But this is perhaps above the Circumstances of an ordinary Gentleman's Estate. The same conveniency for watering would be found, in the steep Hill of the twelfth Figure, provided there were some Water at hand, above the uppermost Ovals. Fig. XII.

If you have a Sloping Wall ready built, and you are unwilling to have all the Heat it does give, you may keep your Trees upon some Frames or Espaliers, at some little distance from the Wall, as half a Foot, or a Foot, or a Foot and a half, more or less, as you intend to take off more or less of the Sun's Heat. Those Frames, tho' not much used in *England*, are yet better.

Frames called Espaliers by the French recommend- ed, to take off some of the Sun's Heat, and to give more liberty to Trees.

ter than the bare Wall, because they leave more room and liberty to Trees.

*A Method
for chusing
the Elevati-
on of a Slo-
ping Wall, in
any Exposi-
tion whatso-
ever.*

Perhaps you may desire to have some Method, for the chusing of the Elevations of your Walls, when they have any other Exposition than to the South, or to the North. I do for this make use, in our Climates, of the following Construction; 'which I do not give as 'a Geometrical one, but only as a 'Mechanical Approximation, for the Solution of a 'Problem perhaps too hard, to be solved, in its 'full Extent, with any great exactness.

'An Exposition being given, in a given Climate, it is easily understood, by what I said before, that all Fruits do not require the Sloping Wall should have the same Elevation: but that 'some Fruits will have it great, some little: and 'that among these Elevations there is two Extremes, to wit, the highest Elevation and the 'lowest, that stand, as it were, for Limits of the 'rest. I call the highest Elevation, the Sloping 'Wall can have, in the given Exposition, simply 'the greatest or highest Elevation; and its proper Wall the highest Wall. And I call the 'lowest Elevation, the same Wall can have, in 'the same Exposition, the smallest or least Elevation; and its proper Wall the lowest 'Wall.

'Let

Let HA be the Horizon, AO the Meridian; AO an Arc equal to the Elevation you chuse to give to your Sloping Wall; when it looks to the North: AP the Height of the Pole. And you may find thus the greatest Elevation of your Declining Wall; whether it declines to the East, or to the West. Draw the Line PO , whose middle is D ; and determine how much more you would take, for the greatest Elevation of your East Wall, than for the greatest Elevation of your West Wall. For I do chuse to give the East Wall a greater Elevation, that it may enjoy the Morning Sun more fully: and to the West Wall a smaller Elevation; that the Sun may come the sooner to shine upon it. Suppose, for instance, you chuse 5 Degrees, or 10 Degrees, for the difference of Elevations, between the highest East Wall, and the highest West Wall. Place those 10 Degrees, for instance, in the middle of the Arc PO , from S to T , and let S be higher than T . And draw the Lines DS , DT . Make the little Circle PDO to serve as a Compass; where the Point O will answer to the North Exposition, and the Point P to the South Exposition. Let your proposed Expositions look, for instance, towards the 60th Degree, taken on both sides the North: and upon the Circle ODP take OE equal to 60 Degrees. The Lines ES , ET ,
L

' $E\tau$, parallel to $D\sigma$, DT , will give, upon the
 ' Arc AP , the greatest Elevations $A\sigma$, $A\tau$, for
 ' the two Walls: to wit, $A\sigma$ for the Wall that
 ' looks 60 Degrees East-ward, from the North
 ' Point of the Horizon; and $A\tau$ for the Wall
 ' that looks 60 Degrees Westward, from the same
 ' Point.

' The smallest Elevations, belonging to the
 ' same Expositions, will be found with taking AQ
 ' equal to the smallest Elevation of the South
 ' Wall, and proceeding, with the little Circle
 ' oq , as was done, with the little Circle or .
 ' Now the Point q cannot be lower than the
 ' Point o . For whatever be the least Elevation
 ' you can give to the South Wall, the North
 ' Wall requires either the same, or a lower:
 ' and never the same, but when it seems incon-
 ' venient, for Vegetation, to give a lower.

' If the Point q happens to be very near the
 ' Point o , as suppose within 5 Degrees from it;
 ' you may, upon the little Circle oq , take ob
 ' of 60 Degrees, as before; and draw to oq
 ' the perpendicular eb , meeting with the Arc AP
 ' in b ; and so you will have the Arc Ab , for the
 ' least Elevation. And, if you think fit, you
 ' may add to and subtract a little from it,
 ' at your pleasure; if you intend to give more
 ' Elevation to the East Wall, than to the Wester-
 ' ly. But let it be so that you may still remain,
 ' be-

“between the Limits o, q . However much Niceness, in so wide a Construction, is probably superfluous.

The Heat remains sensibly the same, for the South Wall, and for the North Wall too, if, keeping their Elevation each, they are made to decline some few Degrees, from the North or from the South. ‘This is partly plain, because the Heat, upon a Wall, whose Elevation is given, is a *Maximum*, when the Exposition is to the South, and a *Minimum*, when it is to the North. And, this not being a sufficient Proof, it is also further evident, by some Calculations, which I forbear to insert here.

The Heat sensibly the same, upon a South or upon a North Sloping Wall, tho’ a little declining from the true North or South.

“For tho’ a *Maximum*, or a *Minimum*, dos not, for the most part, alter its bigness sensibly, when the Elements, from which it results, are but a little changed; yet it happens sometimes, as in the Points of Retrogression of Curves, that a *Maximum*, or a *Minimum* will alter very much, upon the least change in its Elements; as suppose in the Abscisse. And not only a *Maximum*, or *Minimum*, may be found, where the Fluxions of the Abscisse and Ordinate are either of them infinitely greater than the other; but where those very Fluxions have any determinate and finite Proportion among themselves. But a part of this has already been observed by others.

A singular sort of Maximums and Minimums, very different from those that are commonly considered.

The same, in some measure, already observed by others.

*The Ground
of the forego-
ing Method.*

This Equality of Heat is the Ground of the Construction I have given, for determining the Elevation of declining Walls. For it follows easily from it, that the Elevation of the South Wall will remain sensibly the same, tho' it declines, some few Degrees, from the true South; and that the Elevation of the North Wall will also remain sensibly the same, tho' it should decline, some few Degrees, from the true North.

*Experience
must also be
consulted.*

But Experience will be, in all Climates, the properest way to determine, for each Fruit, and each Exposition and Situation, and each sort of Materials, our Walls may be made withal, the Elevation that should be given to Sloping Walls.

*Of Walls
that are not
smooth.*

We must now compare, as well as we can, a smooth and plane Wall, with a rough irregular Wall, and with some other Walls, that are not plane.

In this Theory I have supposed hitherto the Walls to be very smooth and plane. And in that Supposition the Heat is as the Square of the Sine of the Sun's Elevation, upon the Plane of the Wall. But, if it was possible to have a Wall, of an uniform and determinate roughness every where, that could perpetually fold its rough Surface into larger and straight prismatical Furrows, so as to have always one side of the Furrows parallel to the Rays of Light, and the other side perpendicular to them, the Heat would

*There can be
no such thing
as a Wall
giving the
Heat propor-
tional to the
Sine of the
Sun's Ele-
vation upon
it.*

“would then be, and only then, as the Sine
 “of the Sun’s Elevation upon the Wall. Which
 “must be so understood, as not to exclude a
 “Wall, whose roughness vanishes into an exact
 “Plane. I am apt to think that our ordinary
 “Walls, tho’ very rough and uneven, come nearer
 “the first Supposition, than the second. But, if
 “the second was to take place, “TV, TL must,
 “in the fourth Figure, be made equal to the
 “Sines of their proper Arcs TP, TZ: And the
 “Parabolas MV, ML, IV, must be turned into
 “straight Lines, and the rest of ‘the Calcula-
 “tion must be altered accordingly. The result
 “of which would be a much smaller dispropor-
 “tion of Heat than before, between the Sloping
 “and the perpendicular Wall. But, notwith-
 “standing this, there would be yet left a very con-
 “siderable Increase of Heat for Sloping Walls;
 “which would give a sufficient encouragement
 “for the building of them: As will soon ap-
 “pear to you, by an easie Calculation, too
 “obvious after all I have said, for me to ex-
 “plain it any farther. However it is not pos-
 “sible that the Heat should follow this Propor-
 “tion. “If the Heat was supposed as $S^{\frac{1}{2}}$, which
 “is the mean proportional, between the Heats
 “in the two former Suppositions, taking S for
 “the Sine of the Sun’s Elevation upon the Wall;
 “then, TV, TL being duly determined, the Pa-
 “rabo-

*But if there
 was, the
 [Fig. IV.]
 Method of
 calculating
 the Heat up-
 on it would
 be easie.*

*And Slo-
 ping Walls
 would be yet
 very advan-
 tagious, even
 in that sup-
 position; tho’
 less than be-
 fore.*

*Of a Wall
 giving a
 mean pro-
 portional
 Heat, be-
 tween such
 a Wall as
 this and a
 Plane Wall.*

“rabolas would be turned into Parabolas of another Kind, where the Cube of the Ordinate would be as the Square of the Abscisse. And the Calculations would be made after a Method like that I followed before. And the result would come much nearer my first Supposition: tho it would perhaps yet fall short of the true Increase of Heat, upon the Wall.

A smooth Wall compared with a rough Wall.

A smooth South Wall seems to receive more Heat in all, than a rough irregular Wall. But the rough Wall receives more Heat, while the Sun shines very obliquely upon it, than a smooth South Wall would do: And it receives less Heat than the smooth Wall, when the Sun shines near full upon both. For my part I think the smooth Wall to be preferable; not only because it seems to have more Heat in all, and looks much neater, but because it gives no shelter to Insects. The very sloping of a Brick Wall will give an advantage for the polishing or making of it smooth, by the drawing to and fro of a rough and hard Stone sufficiently plane upon it, the Stone being large and suspended from above, to some convenient place for that purpose. But we have one sort of very large and thin Bricks, whose Figure is an exact Square, already polished to our Hands.

How to make a Brick Wall smooth.

Neither should I be very fond of a Sloping South Wall, with some smooth semi-cylindrical

cal Furrows upon it, running from top to bottom, in all the Wall; as in Architecture some Pilasters are often made; the flat part between the Furrows being also very smooth; unless the Furrows were very small indeed; which would bring the Wall so much the nearer a Plane. Any other Furrows would prove too convenient a Nest for Insects. 'I have calculated, more out of Curiosity, than for any real Use, the Proportion of Heat, for an Equinoctial Day, upon such a Furrow, and upon the Plane Wall, or Fascia, that could fill it up to the very Axis; supposing the Atmosphere not to act upon the Rays of Light, and the Elevation of the Walls to be the same, with that of the Pole; and these Walls to be turned directly to the South. And I have also calculated the Heat, that the like Fascia would receive, if it was turned directly to the Sun, for the whole Day.

Of a Sloping Wall with Semi-cylindrical Furrows upon it.

These Furrows compared with a Plane Wall of the same breadth with them.

"In the seventh Figure, where C is the Center of the Lines of Sines OA , AG , make up the Rectangles $CCAD$ and $GCAG$; and upon the Axis AC conceive the Solid formed by the Revolution of the Space $OAGO$, as well as the Cylinder formed by the Revolution of the Space $DEGOD$. The Heat of the Sun, upon the Fascia always perpendicular to its Rays, will be, at the Days end, as the Moment or Weight

Fig. VII.

" Weight of the Cylinder $ODEG$, in reference to
 " the Line OD ; suppose as the Number 9870.
 " And the Heat upon the Cylindrical Surface,
 " will be as the Moment of the Solid OAG , in
 " reference to the Line DE , that is as 2723.
 " And the Heat upon the inclined Fascia, will
 " be as the Moment of the Solid OAG , in
 " reference to the Line OD ; that is as 2467.

" But the inclined Fascia, or the Plane Wall,
 " receives, in proportion to its Surface, much
 " more Heat than the Semi-cylindrical Cavity;
 " as appears both by the very Numbers I have
 " just now given; and by taking upon the
 " Semi-cylindrical Surface a small Space, equal
 " to the like Space upon the inclined Plane
 " Wall. For the Space, taken in the Cylindri-
 " cal Surface, will be seen by the Sun, only
 " for six Hours: And the most it can receive
 " of the Sun's Heat dos but equal the Heat,
 " that the Space taken in the Plane Wall dos
 " receive, from Nine in the Morning to Three
 " in the Afternoon. The Wall with the Cylin-
 " drical Furrows has some Advantage, in that
 " the Solid, between the Furrows, not being
 " thick, it may be heated from side to side, and
 " in that the Reflexion of the Sun-Beams makes
 " the Heat something closer. But the advantage
 " will be greater if the Furrows be very close,
 " and very small, as suppose six or ten or more
 " in

in an Inch: In which case they seem to be even preferable to a Plane Wall, tho' the difference between them can be but little.

"The whole direct or unreflected Heat, upon a Semicylindrical Space ADB , is as the "Sectour DAB , the Line DA being directed to "the Sun, and the perpendicular Heat being expressed by a Height equal to the Radius of "the Cylinder.

"From whence it follows that the Heat, upon the Plane AB , is equal to the Heat, or "Action of the Rays of Light, upon the Cylindrical Space ADB , when the Angle DAB "is of 59 Degrees 4 Minutes, and about 50 "Seconds. And so we leave off considering "of Walls that are not Plane.

I have, for the Reader's satisfaction, calculated, according to the Principles that have been laid down, the following Table, which gives for all Countries, from 40 to 67 Degrees Latitude, the proportion of Heat, in the Summer Solstice, upon a Perpendicular South Wall, and a Sloping Wall passing thro' the Pole of the World. This Space dos comprehend almost all Europe. But, in the South parts of it, I should not much care for our Sloping South Walls, unless it were for some Plants of the hottest Countries, or in a place naturally temperate or cold, upon the side of some little Vale duly

M

cho-

Fig. XIV.
Measure of the
Heat upon a Semicylindrical
Space.

An Account of
a Table giving,
from 40 to 67
Degrees Latitude,
the Proportion of the
Sun's Heat, in
the Solstice, upon
a perpendicular
and a Sloping
South Wall.

The Use of Sloping
Walls, in
very hot Countries,
in such situations as being
high, are naturally temperate
or cold.

chosen in a high Hill or Mountain. And thus those many Habitations, which, being placed very high, are, in all times of the Year, much colder than the neighbouring Plains, and unfit upon that account, even in hot Countries, for the production of good Fruits, may hereafter enjoy that blessing. And this so much the more, that the Heat of the South Wall may, perhaps without danger, be extremely increased there. So, for instance, in the middle of *Spain*, which is a Mountainous Kingdom, the Heat may be made, in the Solstice, ten or fifteen times greater, upon our Wall, than upon a perpendicular South Wall. And this, or rather a part of it, will give a very good help against the coldness of a Situation, proceeding from its Height.

“ Suppose that, in the fourth Figure, the Point
 “ τ is, as before, three times nearer to τ than to
 “ v : and that the Cylindrical Surface TMV is
 “ to the Cylindrical Surface TIV as the Arc $\tau\mu$
 “ to the Arc τv : You will find the Proportion,
 “ between the Cylindrical Surfaces TML , TMV , TIV ,
 “ to be, at the Solstice, as in the following Table.
 “ The first Column gives the Elevation
 “ of the Pole in Degrees from 40 to 67 . The
 “ fourth Column gives the Heat TIV , upon a
 “ smooth South Wall, so much inclined to
 “ the Horizon as to pass thro’ the Pole of the
 “ World; and it makes it always equal to 1000 .

*The Table
 it self, and
 its Explication.*

The

H P	T M L	T M V	T I V	M N	T M L	T M V	T I V	M N
40	65	677	1000	838	100	1043	1540	1291
41	74	690	1000	845	100	930	1348	1139
42	84	702	1000	851	100	835	1189	1012
43	95	714	1000	857	100	755	1057	906
44	106	725	1000	863	100	686	946	816
45	118	736	1000	868	100	626	851	738
46	130	746	1000	873	100	574	770	672
47	143	756	1000	878	100	529	700	614
48	157	765	1000	883	100	489	639	564
49	171	774	1000	887	100	454	586	520
50	185	783	1000	891	100	422	540	481
51	201	791	1000	896	100	394	499	447
52	216	799	1000	900	100	369	462	416
53	233	807	1000	903	100	347	430	388
54	249	814	1000	907	100	327	401	364
55	267	821	1000	911	100	308	375	342
56	284	829	1000	914	100	291	352	321
57	303	835	1000	918	100	276	330	303
58	321	842	1000	921	100	262	311	287
59	340	848	1000	924	100	249	294	272
60	360	855	1000	927	100	238	278	258
61	379	861	1000	930	100	227	264	245
62	399	867	1000	933	100	217	250	234
63	420	873	1000	936	100	208	238	223
64	441	878	1000	939	100	199	227	213
65	462	884	1000	942	100	191	217	204
66	483	890	1000	945	100	184	207	196
67	504	895	1000	947	100	177	198	188
I	II	III	IV	V	VI	VII	VIII	IX

The Explication of the TABLE.

I. Elevation of the Pole in Degrees.

II. Heat upon the perpendicular South Wall, in the Summer Solstice.

III. That part of the Heat, upon the Sloping Wall, that is not affected by the Air.

IV. Heat upon the Sloping South Wall, in the Solstice; its Elevation being the same as that of the Pole.

V. Middle Numbers, between those of the third and fourth Column.

VI. Heat upon the perpendicular South Wall, in the Summer Solstice.

VII. That part of the Heat, upon the Sloping Wall, that is not affected by the Air.

VIII. Heat upon the Sloping South Wall, in the Solstice.

IX. Middle Numbers, between those of the seventh and eighth Column.

M 2

And

" And indeed that Heat would be always the
 " same, if it was not for the different Effects of
 " the Atmosphere, in several Climates, and for
 " the various communication of Heat from the
 " Ground to the Air, and so to the Sloping Wall.
 " The second Column gives, in the same pro-
 " portion, the Heat TML , upon a smooth per-
 " pendicular South Wall: And the third Co-
 " lumn gives that part TMV , of the total Heat
 " TIV , upon the Sloping Wall, that is not af-
 " fected by the Air. The fifth Column gives
 " the middle Numbers between those of the third
 " and fourth. The three following Columns
 " give the same Heats, and with the same Pro-
 " portions; but the Heat, upon the South Wall,
 " is always exprest by 100. The ninth Column
 " gives the middle Numbers, between those of
 " the seventh and eighth. The real direct or
 " unreflected Heats, upon the Sloping Wall, be-
 " ing determined, by the Atmosphere, to some
 " Number between TMV and TIV , they cannot
 " be very far from the Strength exprest in the
 " fifth and ninth Column.

*The Use of
 the Table.
 Example for
 Paris.*

The Use of the Table is as follows. Sup-
 pose I would know what might be at *Paris*, in
 the Solstice, the Proportion of Heat, between a
 perpendicular plane South Wall, and a Sloping
 plane South Wall, passing thro' the Pole of the
 World. I take the Height of the Pole at *Pa-*
ris,

ris, which is 49 Degrees 50 Minutes. " And o-
 " veragainst this Number I find TML, TMV, TIV
 " must be 183, 781 and 1000. Or else that
 " they must be 100, 427 and 548. I will
 " use these last Numbers, as being more conve-
 " nient. I conclude therefore that, the Heat,
 upon the perpendicular South Wall, being sup-
 posed of 100 Parts, the Heat, upon the Slo-
 ping Wall, is already, upon a consideration,
 which is not at all subject to the Effects of
 the Atmosphere, of 427 Parts. Besides an ad-
 ditional Heat of 121 Parts, that would raise it
 to 548 Parts, were it not that from this Num-
 ber, 121, something is to be subtracted, because
 of the Effects of the Air. The last Column
 gives the middle Number 487; which we may
 suppose is not far from the real Heat upon the
 Sloping Wall. And this is about $4\frac{1}{2}$ times great-
 er than the Heat upon the perpendicular Wall.

" But if we go about to calculate the Heat,
 " upon the Sloping South Wall, that passes thro'
 " the lowest Point of the Polar Circle, we shall
 " find the Increase of Heat, upon it, to be yet
 " much greater.

" And in general a Sloping South Wall, ele-
 " vated at Paris, upon the Horizon, by so much
 " as is the Height of the Pole, wanting the whole
 " Distance between the two Tropicks, being much
 " hotter in the Solstice, than the Sloping South

" Wall,

*Of South
 Walls that
 are more in-
 clined, to the
 Horizon,
 than the Wall
 that passes
 thro' the Pole
 of the World.*

*Perpendicu-
 lar and Slo-
 ping South
 Walls may be
 well compar-
 ed together
 in the same,
 but not in dif-
 ferent Cli-
 mates.*

“Wall, that passes thro’ the Pole: it follows
 “that any South Wall whatsoever, whose Ele-
 “vation, upon the Horizon, is there between
 “2 Degrees 50 Minutes, and 49 Degrees 50
 “Minutes, must be hotter also.

This comparing together of perpendicular and Sloping South Walls proceeds well enough, for the same Climate, whether it be often cloudy or often fair: provided the Clouds do not use to come more at some certain hours of the Day than at others: suppose more about Noon than in the Morning. But we cannot, from the Table, determine safely the Proportion of Heat, between the perpendicular and Sloping South Walls of several Countries; the Interposition of the Air, and especially the difference of Weathers being almost an insuperable Obstruction against it.

*Of some o-
ther Advan-
tages of Slo-
ping Walls.*

In the Tract of this Discourse, I have, in several places, shewn some of the Advantages we get by using Sloping instead of perpendicular Walls. I will now run over some other Advantages, that are yet untouched, or else not fully treated of.

*In reference
to Dew and
Rain; espe-
cially as to
the East
Wall.*

Our Sloping Walls enjoy much more the benefit of the Dew and Rain’s falling, than other Walls can do. And the East Sloping Wall will not have, as the perpendicular, that great fault of keeping the Rain from its Trees.

The

The consequence of this will easily be perceived, by those that complain so much of the Drought incident to their East Walls.

It is a common fault, in all perpendicular Walls, that the Ground being wet, and transpiring much humidity, this will stick upon the tender Blossoms, and in cold weather cover them with Frost, and destroy them. If our Sloping Walls do not intirely prevent this, they cannot but do it at least in a great measure: the very sloping of the Tree turning it from those Steams, and giving room for them to dissipate themselves in the Air. In like manner our Terrasses will have an advantage in reference to Frost, occasioned by the cold Vapours in the Air driving with the Wind and sticking upon Trees. For one Terrasse dos defend, in a great measure, the following Terrasses against this Accident.

By our Theory the Extent of those Places, where several Fruits do grow, will be much enlarged. And not only two Zones of some Miles, or perhaps of some Degrees, round the whole Earth, one of each side the Equator, will be made able to produce, for instance, some good Grapes, whereas they afforded before only some bad or indifferent ones. But in Countries, where Vines do grow plentifully, if you mark upon the Hills, or Mountains, those Limits, where Vines do begin to be but bad or indifferent, even against

In reference to Frost occasioned by the Earths transpiring some moisture:

Or by the cold Vapours in the Air driving with the Wind, and sticking upon Trees.

The growing of Fruits extended to more Countries and Places.

gainst Walls built after the ordinary way ; you may often take in yet a great deal more of Ground, with several Country Houses and Towns in it, and have there some excellent Vines, by the help of Sloping Walls. What is here said of Vines is, in like manner, easily understood of other Trees.

So then whereas every Climate in Europe begins to lose some sorts of Fruits, for want of Heat and Time to ripen them ; we may every where open our Gardens to receive those Fruits, which hitherto we have been unable to have, tho' our near Neighbours Southwards did raise them, with no extraordinary trouble.

And the time of their Ripeness, and use for Men, to more Days in the Year.

And not only the Places for the growing of Fruits are enlarged, but so are the Times also, in which we may enjoy them. This advantage arising from our Walls giving probably their Fruits a Week, or perhaps a Fortnight, sooner

Ordinary Walls compared among themselves, and with Sloping Walls, as to the forwardness of their Fruits.

than we could have them otherwise. For since at Paris the Fruits of good Espaliers are something sooner ripe, than those of Standard Trees ; and these last are sooner ripe, than those of Dwarf Trees : And, among the Espaliers, those of the South and of the East begin to give some ripe Fruits about eight or ten Days sooner than those of the West, and about, at least, fifteen or twenty Days sooner than those of the North ; is it not easie, from thence, to conclude that our Slo-

Sloping South Walls and East Walls will give their Fruits considerably sooner, than ordinary Walls can do?

The Certainty of our latter Fruits coming to Ripeness is also much greater; since, by our having them early, we need not fear so much the beginnings of cold and wet Weather, that might hinder them from coming to Perfection.

The Certainty made greater of our latter Fruits coming to Perfection.

Walls may not only be so exposed, and so inclined, as to make several sorts of Trees, growing against them, to bear early some excellent Fruits; but, according to the same Idea, the Ground it self may be so shaped, into Slopes and Terrasses, as to bring early some of the smallest sorts of Plants, as Strawberries, Sallets &c. And as for such Plants, as cast a pretty deal of Shade, tho' the same Sloping Ground might serve very well for them, yet one might also use, with some more advantage, a main Slope cut by Stories into several small ones faced with Bricks, as you see in the fifteenth Figure.

Slopes of Earth for smaller Plants.

Of the dividing a main Slope into many small ones.

Fig. XV.

In the like manner we might easily so shape the large Furrows of our Fields, or the Surface of our other Grounds, as to have them exposed to the Sun, with the same Obliquity, as the level Ground of any Country, not above 10 or 15 Degrees more to the South, or North, than we are our selves. For instance, in the Latitude of London, the Ground will have the

Of shaping the Level or ordinary Ground, into very large Furrows running East and West, with a gentle Slope Southwards, and a steep one Northwards, or contrarywise; in order to increase or diminish a little the Sun's Heat.

Fig. XVIII.

the same

same Exposition to the Sun, as the level Ground, in the Latitude of 45 Degrees, if going from South to North, you make, suppose for five Yards together, your Ground to rise by an Angle of $6\frac{1}{2}$ Degrees, in a Slope exposed exactly to the South; and then you make your Ground to fall as much towards the North, by a Slope as steep as it can conveniently be, suppose of 35 or 40 Degrees: and then you begin again another long and gentle Slope towards the South, for five Yards together, to be followed as before, by a short and steeper Slope towards the North; and so on. See the eighteenth Figure. Tho' we do not, by this, give the same Weather, or Heat, to the Climate, nor the same Strength, or Weakness, to the Sun, as there is in a Country, where its Rays do not pass thro' so much or so little Air; yet at first sight it seems to be of some consequence for Agriculture, both in cold and in hot Countries; and I could not forbear proposing it to the consideration of the Curious. If, in our Example, we do not get that degree of Heat, they have naturally in the Latitude of 45, supposing both Countries equally cloudy; yet, with the very Numbers I gave, we may possibly reach, upon our Ground, the Heat, which they have in 48 Degrees Latitude; and we may yet come nearer the Heat, which the Ground has in the Latitude of 45, if we make our Slope, that looks to the South, a
lit-

little steeper; raising it, for instance, 10 or 12 Degrees above the Horizon. There is some Ground lost here, tho' not very much. As to the Trouble it is not greater than we see Country-men take, to make the Water to run off their Fields. And we have this conveniency, that we may give our Slopes only what Breadth we please; suppose as much as will result from the strength of a Man to throw, with a Shovel, the Earth from him. But the broadest Slopes are best.

Thus we may help and increase a little, by the shape of our Ground, the Heat of the Sun; or else we may abate a little from it. And by consequence we may fit our Lands the better, to bear any Plants we have a mind to raise. This may serve to guide such as would plant some Vines in their Country, whether it be naturally a little too hot or too cold. For it will either lead them, as daily Experience dos others, to chuse a Ground fitly exposed and inclined for their purpose: or else, if their Ground be not proper, it will let them see a possibility and a Method, with a little trouble, to make it so.

Every body knows what great difference of Heat and Vegetation there is, in the same Climate, between the North and South side of great Mountains; and the like is, in some measure, observed, at much smaller distances, in our Hills. I remember that travelling once in England, in

*Application
of this Practice
to Use.*

Of the difference of Heat, upon the North and South side of Mountains, Hills and Downs.

Summer, over some Downs, which had but an ordinary Declivity, one could plainly perceive, by turns that the Air became of a suddain much warmer; when the Declivity was towards the Sun; and colder, when it lay from it. Yet the Sun being high then did shine upon the whole Ground.

The Heat of the Air in any place does not very easily spread into the next Air.

In any Shade, and even in our Woods, tho' the communication be so open with the very next Air, warmed immediately by the Sun; and its Rays are let in at several places, yet the coolness is very sensible; the Heat spreading from the ambient Air, with less ease, than one is apt to think. These considerations incline me to believe that, by this shaping the Ground, there may be something done for the benefit of smaller Plants, especially in a close place, or calm weather, when the reflected Heat may not be blown away from the Ground that reflects it. For it seems each Surface of Ground makes then, close about it, as it were a peculiar Climate.

Nor the reflected Heat spend it self so fast, but that it may be strongly felt.

And this is farther confirmed, by the common Experiment we have, how much hotter it is, in Summer, near a South Wall, or a row of Houses, that look to the South; when the Sun shines full against them, than in any other place, where the Light of the Sun comes with the same Liberty. For it is plain the reflected Heat, being thus perpetually supplied from the Sun, does not so much spend it self, into the open Air, but

but that it may be strongly felt, at some distance, all along the place that reflects it.

I cannot here but mention what I heard a learned Gentleman say, who has been in the *West-Indies*. He assured that upon their Mountains, according as one goes up higher and higher, and the Heat dos become less, one finds, by degrees, very many of our European Plants naturally growing; the Mountains always giving them, in some peculiar places, as it were different Climates, fitted to their several Natures. So then, as the Diminution of Heat makes the Ground naturally to bring forth the Plants of colder Countries: so, on the other side, the Increase of Heat, which in a great measure lyes in our power, must needs fit our Grounds, and Gardens, for an easie and natural Production of the Plants of such Countries, as are hotter, only to a certain degree, than ours.

The use of Sloping Grounds, for smaller Plants, is pretty well known already; especially beyond Sea. And as for these Climates, not to mention what they call in French *des Ados*, I have heard that a Gentleman, who lives at *Dublin*, has in his Garden a pretty easie Slope well exposed; which furnishes him with Straw berries, long before they be ripe in other Gardens; and with such Strawberries too, as have a colour, smell and taste, to which the others are not to be compared.

*An Account
of a Slope
where extra-
ordinary
Strawberries
are said to
grow.*

*Advantage
of Sloping
Walls, in
such Days as
the Sun is
seen for some
Hours only.*

It happens pretty often that the Sun does shine only some part of the Day; which makes, at such times, perpendicular Walls, in the Spring and Summer, to be frequently altogether without it. But Sloping Walls, having before them a much greater part of the Sky, are so much the more likely to enjoy the Sun, if it comes at all to be seen. This advantage, as well as that of enjoying more fully the Sun, at any Moment it happens to shine, is so much the more to be valued, when the Climate is apt to be Cloudy, and subject to much Rain.

*Advantage
of inclining
Sloping Walls
more or less,
according to
the Climate,
Situation
and Exposition.*

In pretty hot Countries, or in Climates, where their perpendicular South Walls are already as hot, as they desire to have them, one may often, by inclining another Wall, to a proper quantity, make any Exposition, from the North East Southwards to the North West, to be equal in Heat to a perpendicular South Wall. The like may be said of a perpendicular South East Wall, &c: If it be the best perpendicular Wall, in your Climate, you may make several other Expositions not to be inferiour to it, by inclining the Walls, as much as is necessary. And further, suppose Experience has taught, in your Country and Situation, the best East-South-East Wall, for instance, to be, for such a kind of Fruits, that, which is elevated 75 Degrees upon the Horizon; you may

may give such an Elevation to another Wall, in another given Exposition, as will receive an equal Degree of Heat with the former.

Very few Grounds have so much good Earth, as is necessary for Fruit Gardens. The charge of bringing some, from another Place, is very great: And, unless one fetches it from far, there will probably be, too near the Garden and the House, some large unsightly place left in a manner barren and desolate. Neither is it practicable to take away the good Earth, from some Parts of your Garden, to bring it to some other Parts; except as far as your Alleys, and such other Places, will give leave. But, in a Garden for Fruit, made as I shall presently describe, one may find, upon the Spot, so much good Earth, as will much more than double the natural Depth, there was of it before; thō you should plant your Lines of Wall Trees, in the middle of a plat of good Ground, eight or nine Foot wide. And all this may be done, without altering at all the Beauty or Symmetry, of your Disposition.

Advantage of Terrasses with Sloping Walls, in reference to a sufficient quantity of good Earth, which is easily procured.

The sixteenth Figure is the Ground Plat of a Garden for Trees, made up into Terrasses.

It is an exact Square of 470 Foot on each side: that Figure not being so offensive, in our Disposition, as it is in that which is common. If you would have a bigger Garden you may keep the

Description of a Garden for Fruit, according to the present Theory.

FRUIT-WALLS

*The Use of
making the
outside Wall
thicker at bot-
tom than at
top.*

the same Breadth, and add two, or four, or six, or eight Terrasses more &c, and order it so that the Door may still remain in the middle. If you design to have a smaller Garden, you may make the Length of your Terrasses less, by 50, or 100, or 150 Foot. And if you would have it smaller yet, you may, instead of ten Terrasses, make only eight, or six, &c. The outside Wall is about 10 Foot high; and broader at bottom, than at top. The Breadth at bottom is 3 or 4 Foot. The Breadth at top might be made of 8 Inches; and it would be better yet, if the Wall ended there into a sharp Edge. The sides of the Wall are plane; and so they must needs be somewhat Sloping. Tho' this may perhaps seem to be of little consequence, yet I do not doubt but it will be a considerable advantage for this Wall, to enjoy thus the Sun, near the Solstice, for about half an hour, or an hour, longer of each side, than it could otherwise; and at the same time to enjoy it more fully. To which advantage there must also be added that of a greater Solidity; which will make the Wall to be more lasting, and seldom to want any Reparations. On the inside of this Wall is a Line of four or five Foot of cultivated Ground; then an Alley round the Garden, and a Chancel, or deep Trench, that may serve for a Drain to the Garden. I did suppose in the

*A kind of
Chancel, or
Ditch, to
keep the Gar-
den from too
much Water.*

the Figure that this Canal was faced on each side, with a competent perpendicular Brick Wall. But it should always have some Water, whose Surface ought to be about three or four Foot lower than the Level of the little Walks. One or two of those little Wind Mills, that turn alone towards the Wind, and are so common in the Fields in *Holland*, might serve to empty this Ditch, lest it should grow too full; and, if one would, they might also serve to distribute the Water of it to any other place, or to the Alleys, in order to water the Trees. Those Wind Mills might be placed either within or without the Garden; as you think it most convenient. The Breadth of the Canal must be considerable, if you design it for state and ornament; but it may be little, if you design it chiefly for use. Unless the necessity of having some Earth from thence, for the Terrasses, makes you to chuse a large Canal. Under the Middle of the Alleys, a cross the whole Garden, should be as it were a Common-shore, to receive all the superfluous Water of the Alleys, and to carry it into the Ditch. And, if one such Common-shore was not sufficient, one might have two placed at equal distances, from the Middle of the Alleys; so as to leave between them about half the length of the Alleys, or very little more. After the Ditch comes a little Path, and a Line of cultivated

O Ground.

Ground. Then the Slope of the main Terrasse round the Garden. Then an Alley at the top of it. Then the inner Slope of the main Terrasse. The rest are the lesser Terrasses, with their respective Slopes on each side ; their Thicknesses at top ; the cultivated Grounds at the foot of them, and the little Walks between. The Door, and Bridge, and main Staires, to get up the main Terrasse, and lesser Staires, to go down from it into the Alleys, are easily perceived in the Figure ; whose particular measures are as follows

*Measures of
the Slopes,
which are
respectively
made equal.
But being
made diffe-
rent they may
be better fit-
ted for seve-
ral Fruits.*

hereafter. Tho' the Slopings, in all the little Terrasses, have been made the same, and such as are properest for latter Fruits, yet it would be more convenient to have them something different. The perpendicular Height of the Terrasses is 8 Foot. The Slopes that look to the South are elevated 51 Degrees 30 Minutes, above the Horizon. Those that look to the East 45 Degrees. Those that look to the West 35 Degrees 22 Minutes. And those that look to the North 28 Degrees 53 Minutes. The Height of the South Walls taken along the Slope is 10 Foot 2½ Inches. That of the East Walls 11 Foot 3½ Inches. That of the West Walls 13 Foot 10 Inches. And that of the North Walls 16 Foot 6½ Inches. The Bases of the Slopes that look to the South, to the East, to the West, and to the North have in Breath 6 Foot 4½ Inches, 8

Foot,

I M P R O V E D.

99

Foot, 11 Foot 3 $\frac{1}{2}$ Inches, and 14 Foot 6 Inches.
The Door is towards the East.

Expositions of the Walls.	Height of the Walls in the Slope.		Elevations of the Walls above the Horizon.		Bases of the Walls or their <i>Talus</i> .		Perpendicular Height of the Walls.	
	Feet.	Inches.	Deg.	Min.	Feet.	Inches.	Feet.	Inches.
South.	10.	2 $\frac{1}{2}$	51.	30	6.	4 $\frac{1}{2}$	8.	0
East.	11.	3 $\frac{1}{2}$	45.	0	8.	0	8.	0
West.	13.	10	35.	22	11.	3 $\frac{1}{2}$	8.	0
North.	16.	6 $\frac{1}{2}$	28.	53	14.	6	8.	0

*A Table
shewing the
Heights, E-
levations and
Bases of the
Walls.*

Here I bring into one Table the several Heights,
Elevations and Bases I said did belong to our
Sloping Walls.

I go on to give the Measures of two several
Sections cross our Garden.

O 2

Mea-

*Measures taken across the Garden, going from
South to North.*

*Measures for
the Ground
Plat taken
across the
Garden.*

Feet. Inch:

1. 6 **E** External Slope of the Wall.
 0. 0 Breadth of the Wall at Top.
 1. 6 Internal Slope of the Wall.
 4. 8 Cultivated Ground.
 16. 4 Alley.
 19. 4 Ditch or Canal.
 2. 0 Path.
 4. 8 Cultivated Ground.
 6. 4 $\frac{1}{2}$ Slope looking towards the South.
 13. 0 Alley at the Top of the main
 Terrasse.
 14. 6 Slope looking towards the North.

Sums.

4. 8 Cultivated Ground.
 4. 9 $\frac{1}{2}$ Path or Alley.
 Feet. Inch: 4. 8 Cultivated Ground.

28. 0 ———

6. 4 $\frac{1}{2}$ Slope looking towards the South.
 1. 0 Thickness of the Terrasse at Top.
 14. 6 Slope looking towards the North.
 4. 8 Cultivated Ground.
 4. 9 $\frac{1}{2}$ Path or Alley.
 4. 8 Cultivated Ground.

36. 0 ———

Di-

Feet. Inch:

36. 0	Divided as before, or with what Alterations one pleases.
36. 0	Divided as before, &c.
36. 0	Divided as before, &c.
36. 0	Divided as before, &c.
36. 0	Divided as before, &c.
36. 0	Divided as before, &c.

Feet. Inch:

6. 4	Slope looking towards the South.
13. 0	Alley at the Top of the main Terrasse.
14. 6	Slope looking towards the North.
4. 8	Cultivated Ground.
2. 0	Path.
19. 5	Ditch or Canal.
16. 4	Alley.
4. 8	Cultivated Ground.
1. 6	Internal Slope of the Wall.
0. 0	Breadth of the Wall at Top.
1. 6	External Slope of the Wall.

84. 0

470. 0

Total Sum.

Meas.

Measures taken across the Garden, along one of the small Alleys, going from East to West.

Feet. Inch.

- 7. 8 Wall and Cultivated Ground.
- 42. 4 Alley, Ditch, Path, Cultivated Ground.
- 8. 0 Slope looking towards the East.
- 13. 0 Alley.
- 11. 3 $\frac{1}{4}$ Slope looking towards the West.
- 305. 5 $\frac{1}{2}$ Length of the Alley and small Cultivated Ground.
- 8. 0 Slope looking towards the East.
- 13. 0 Alley.
- 11. 3 $\frac{1}{4}$ Slope looking towards the West.
- 42. 4 Cultivated Ground, Path, Ditch, Alley.
- 7. 8 Cultivated Ground and Wall.

470. 0 Total Sum.

But, with increasing the Breadth of the Canal every where, by 15 Foot more, the whole Breadth and Length of the Garden would be 500 Foot each.

If

If the Garden be designed for Vines only, the Terrasses need not, I suppose, have more than 4 or 5, or at most 6 Foot, in the Slope that looks to the South; and accordingly they will be smaller, and nearer one another; and by consequence they will be less chargeable; and the same Extent of Ground will yield more Fruit.

Of a Garden for Vines only. It requires but small Terrasses.

Supposing the Ground not to be of the very best sort, but of a middling kind, between that, and the sort of Ground Monsieur La Quintinye calls indifferent; the Garden, whose Measures I have just now given, would hold almost 1600 ordinary Fruit Trees; taking in those that may be placed against the outside of the Wall, that goes round the Garden. This will appear upon examining the three following Tables, where I make yet no allowance for the Trees growing bigger, against our Walls, than against the ordinary ones. But the Tables however will very well serve, to guess at the Quantity of Fruits, that will be produced. And this must be with allowing for each Tree according to the common rate of their Fruitfulness.

Of the Number of ordinary Trees the Garden could hold:

From whence it is to be estimated the Number of its Fruits.

Height

*A Table
shewing the
Heights and
Lengths and
Expositions
of the Walls.*

Height of the Wall taken along the Slope.		Length of the Wall.		Exposition of the Wall to the Hea- vens.	The Walls spoken of in this Table.
Feet.	Inches.	Feet.	Inches.		
10.	0	456.	0	East.	Outside of the Wall that goes round the Gar- den.
10.	0	468.	0	South.	
10.	0	468.	0	West.	
10.	0	468.	0	North.	
10.	0	458.	8	East.	Inside of the Wall that goes round the Garden.
10.	0	458.	8	South.	
10.	0	446.	8	West.	
10.	0	458.	8	North.	
11.	3½	347.	6	East.	Outside of the main Terrasse round the Gar- den.
10.	2½	360.	4	South.	
13.	10	359.	6	West.	
16.	6	360.	4	North.	
11.	3½	27 Trees		East.	The Nine little Walls, at the Bottom of the Nine Alleys.
20.	2½ and 13.10	9 Trees		South and West.	The Nine Corners at the right hand, at the going into the Alleys.
16.	6½ and 13.10	9 Trees		North and West.	The Nine Corners at the left hand, at the going in- to the Alleys.
16.	6½	297.	0	North.	One of the North Walls of the lit- tle Alleys.
16.	6½	2376.	0	North.	The remaining 8 North Walls.
10.	2½	297.	0	South.	One of the South Walls of the lit- tle Alleys.
10.	2½	2376.	0	South.	The remaining 8 South Walls.

This

This first Table allows twelve Foot to the Gate and Pillars ; and makes the Length of a Sloping Wall middlemost, between its Length at Bottom, and its Length at Top. Only, as to the long Slopes of the little Alleys, observe that they are set down less by $8\frac{1}{2}$ Foot, than what they really are at Bottom : So much being allowed, for the spreading of the Trees in the Corners.

The Result of the first Table is here set down in the second.

East.		South.		South and West.	
Length and Height of the Walls.		Length and Height of the Walls.		Length and Height of the Walls.	
914. 8.	10. 0	926. 8.	10. 0	Trees. and	10. 2 $\frac{1}{2}$
247. 6.	11. 3 $\frac{1}{2}$	3033. 4.	10. 2 $\frac{1}{2}$		
27 Trees	11. 3 $\frac{1}{2}$				13. 10
West.		North and West.		North.	
Length and Height of the Walls.		Length and Height of the Walls.		Length and Height of the Walls.	
914. 8.	10. 0	Trees. and	16. 6 $\frac{1}{2}$	926. 8.	10. 0
359. 6.	13. 10			3033. 4.	16. 6 $\frac{1}{2}$
			13. 10		

Short Table giving the Result of the former.

Monfieur La Quintinye divides our Wall Trees into two Classes : and, according to him, if the Ground be between very good and indifferent

P

fer cent

Some Suppositions taken from Monfieur La Quintinye :

F R U I T - W A L L S

ferent Soil, the Walls, whose Height is in the Table 10 Foot and 10 Foot 2½ Inches, require the Trees of the first Class to be at eight Foot six Inches distance asunder; and the Trees of the second Class to be at seven Foot three Inches distance asunder. The middle Number between those is about 8 Foot. But the Walls, whose Height is in the Table 11 Foot 3¼ Inches, and 13 Foot 10 Inches, and 16 Foot 6¼ Inches, require to have their Trees alternately intermixt, with making them by turns a high one and a low one: and their Distances must be about five Foot three Inches, one with another.

By which
a Table is
made of the
Number of
ordinary
Trees, the
Garden
would have.

According to these Determinations, the last Table will give the following Numbers of ordinary Trees.

East.		South.		South and West.
Trees.	Distance.	Trees.	Distance.	Trees.
114	8	116	8	9
66	5½	379	8	
27	5¼			

West.		North and West.	North.	
Trees.	Distance.	Trees.	Trees.	Distance.
114	8	9	116	8
68	5½		577	5¼

The

The total Sum of Trees is 1595. And for one Tree, that takes up 8 Foot Space, you may substitute, if you please, $3\frac{1}{2}$ Vines. But if the Ground be very good the Number of Trees will be less.

So then our Garden might hold 1300 ordinary Trees, and 1000 ordinary Vines; or 1400 ordinary Trees, and 680 ordinary Vines. And from thence must be estimated the Number of its Fruits.

But it would be very unwise to make such high Terrasses, to serve for Vines only. For that Plant being of such a Nature, as not to do well in these Countries, if it be suffered, as it is too often done, to spend its strength in nourishing an overgrown Stock; we may follow their Directions, that advise us to keep it so low, as to give, for instance, to Muscat only the Height from three Foot to five. A Terrasse for Vines would then be great enough, unless I mistake in drawing this conclusion, if it was but half as high as those I have described. Neither would it be necessary to allow more than half the Breadth, we did give to our Alleys, or very little besides.

And since this great narrowness might prove troublesome, because of the Rain, I would in building the Terrasses spare, within, and at a good Depth under each of them, a little paved Ditch, to carry off the Rain at both Ends, and to keep the Alleys clear of too much Water. The same

3½ Vines to be substituted for one Tree.

General Sum of ordinary Trees and Vines in the Garden.

Of Terrasses for Vines only. Vines ought to be kept very low.

La Quinti-nye.

might also be conveniently done, in building any Terrasses, thô never so big.

*Of a large
Terrasse par-
ted into two
for Vines.*

But, if you think it too improper, to have in one Garden a mixture of large and small Terrasses, you might cut one great Terrasse so, as to afford, in the middle of its Height, a Step for another row of Vines; as you see in the seventeenth Figure. I should however, upon

Fig. XVII.

many other Accounts, and also for fear of the Vines of the lower part of the Terrasse intangling with those of the upper part, rather chuse to have a whole Garden for Vines, excepting only the bad Walls in it: And such might be, after some few changes, the sixteenth Figure; if we suppose the outside to be only of 240, or 300 Foot.

Fig. XVI.

*The Garden
will not hold
so many
Trees, as it
would, if they
were to keep
within the
ordinary
Size.*

*The Trees in
it will grow
very large
and why:
And must be
far asunder:*

Now, as I did already intimate once before, our Garden will probably not hold so many Trees, as are set down in the last Table. For there being more room with our Walls, than with the ordinary ones, for the spreading and growing of the Roots round about, they will make their Trees undoubtedly to grow bigger, and larger every way. The best Fault, in determining the Distances, between the Trees, is to make them too big at first; for fear of the Confusion, and want of Fruitfulness, that attends those Distances, when they are made too small. However in this we find a new advantage of our Gardens; since a smaller Number

ber of Trees will garnish the same Extent of Walls, and give no fewer Fruits, than a greater Number would have done; and will be withal more vigorous and lasting. But the Difficulty lies in guessing at the Distances we must chuse. For my part I would, for the first Tryal, if the Ground be good, not only make them as great, as the Distances, Monsieur *La Quintinye* determines, for the very best sort of Ground; but make them yet, by about one sixth or one fifth part bigger. Neither would I begin to mix alternately big Trees and little Trees together; unless the Wall were, at least, twelve Foot high.

Yet will not yield a less Crop of Fruits.

They will be more lasting.

A guess at their Distances.

See La Quintinye Vol. II. p. 294. and Vol. I. p. 208. &c.

We must take notice here that the *Paris Foot*, used by Monsieur *La Quintinye*, and after him by me, is to that of *London* as 16 to 15. So that to the *London Foot* one must add $\frac{1}{4}$ of an Inch, to make it a *Paris Foot*.

Proportion of the London Foot to that of Paris.

I have drawn, with a great deal of care, according to the Rules of Perspective, in a large Print by it self, the Elevation of the South-West Corner of our Garden. Any body may judge, by the effect of this Figure, particularly with hiding the lower part, whether Sloping Walls and Sloping Trees will be much offensive to the Eye. For my part I think it may be a question whether an ordinary Fruit-Garden, with perpendicular Walls, can ever be made to look so pleasant.

A Draught of the Garden in Perspective. Pag. I.

sant, and so full of a regular and stately variety, as I find the Figure to be. That stateliness is altogether owing to those great and massy Terrasses, which, in our Draught, overrule, as it were, and master the whole; and have an effect like to that of very large Columns, in our Buildings. They have besides, from so many Trees set against them, in a regular order, that Airiness and Gayity, which arise in our Architecture, from abundance of proper Ornaments. The Canal is made broader than according to the measures of the Ground Plat. It will not only be nobler, if it be very broad; but, if you have no natural rising, in the midst of your Ground, it may yield also the Earth necessary for the Terrasses, without sinking the level of the Garden. The Figure will help to conceive how some Roofs might be used, instead of Terrasses.

*Division of
a large Gar-
den, by some
Canals, into
four or six-
teen little
Gardens, or
any other
Number.*

*This will yield
the Earth neces-
sary for the Ter-
rasses.*

If the Garden be very large, and you are at a loss where to have all the Earth, that would be required; even thô you should pretty much increase the breadth of your Canal; keep the outermost square Terrasse untouched; and in the middle of your Ground Plat, draw, from side to side, a large Canal, like a Cross, ending at the four ends perpendicularly against the main Terrasse. This new Canal will give the Earth you want: And each of the four Divisions of the

the Garden must be finished by it self, according to the Idea I have followed, in the sixteenth Figure. Only the new Terrasses, that go round the inner half of the four Divisions of the Garden, and make up the Banks of the new Canal, should not be so large, as the main Terrasse.

After the same way, if the Extent of the Ground was extraordinary great, and there was yet some Earth wanting, one might again, by four new Canals like a Cross, subdivide each of the four last Divisions: which would give sixteen small Gardens in all. If these Canals be designed for several Ponds, where you may keep different sorts of Fishes, they need not have any communication one with another. But if you would have the liberty of going every where, with Boats, among the Gardens, it will be sufficient, if all the Canals be opened, and continued into one another, along that Branch of the main Cross, which the Bridge does come up to: excepting only that part of the main Terrasse, the Bridge ends against. Thus you might go, at your pleasure, either with a Boat, or walking, to any one particular Garden. As the outer Terrasses are made less and less, according as their Length decreases, so should also the Canals be made less and less broad. Now, by such Canals, your Garden might be divided, not only into four or sixteen smaller Gardens, but into any other Number.

And either
give different
Ponds
for several
sorts of Fishes:
Or, else
open the
Way, by
Boats, among
the
Gardens:

And leave
also a Foot
Way into
them all,

Thô

Any ordinary Gentleman may have a few Terrasses, or Slopes, well exposed.

Tho' such large and magnificent Gardens can only be the Work of Princes, and other Great Men, or of powerful Societies; yet there is no ordinary Gentleman, that is able to have a Garden, but may, according to his ability, and the Directions I have given in other places of this Discourse, have one or more Terrasses, or Slopes, well exposed, of what length he can afford: So that he may have, against them, a competent number of Vines, and other Trees. And whereas they say now, for instance, I have got fifty Yards of very good Wall; they may say hereafter, to a greater commendation of their Gardens, I have raised 30 or 40 Yards of a Sloping South Wall.

A Tryal of Sloping Walls not to be depended upon, unless made by a very good Artist.

It may happen that, upon some Tryals made by an unskilful Artist, our Walls may seem not to be of any use, for the Production of good Fruits. But ordinary Agriculture does not now thrive equally, in everybody's hands. And whilst a diligent and understanding Country Man is largely repaid for his Care and Industry, the unskilful often sees himself deceived in his hopes. There will ever be a just distinction, between those that act by the certain Principles of an Art grounded upon Nature, and such as act in a great measure by chance. The same Instruments, according to the several Applications that are made of them, being managed by two several Hands,

Hands, produce often both what is deservedly admired of one side, and what is as deservedly despised on the other. In a word, I do not hope, by this Theory, to make all Gardeners equal among themselves. But I give them, in all Countries, an easie, and natural, and very great Increase of the Sun's Heat ; which may often assure them of an extraordinary Success ; tho' without excluding the necessary Care and Skill, which after all is the most significant Part.

A good Culture more significant than a good Exposition.

If what I have been proposing might, at any time, have been acceptable and useful to Mankind, it must certainly be so now. Every body has been sensible, for these twelve or fifteen Years, of a very great, and, as some think, unaccountable Change in our Seasons. Our Summers are much colder than they were ; and 'tis but seldom they bring us any Thunder. Their Influence is felt in many of the Productions of the Earth ; particularly in all sorts of Fruits, that come late in the Year : for such have no Heat to bring them to perfection. And the unsettledness of our Springs commonly destroys the very first hopes we have, at the blossoming of our Trees. The cause of this Change, in our Seasons, is often the Subject of common Discourse : And it is no wonder to see how wide and empty the guesses of most people are, upon that matter. This is certain, and was made out

Sloping Walls very necessary, while our Summers continue to be so cold.

Q

here-

The cause of that change in our Seasons referred to a Phenomenon like Smoak, that incompasses the Body of the Sun, and is seen to spread an exceeding great way from it.

heretofore past dispute, that from the Year 1683 downwards, and I say now even to the present time, the Sun has been in the very Middle, or Center, of a thin Mist of a prodigious Extent; which, incompassing the whole Body of the Sun, spreads near the Plane of the Ecliptick, so as to reach almost the great Orb of the Earth; resembling much, in its Figure, an ordinary Ocular Glass, or Lens, equally convex on both sides. Its Thickness or Opacity (not where it is greatest, but where we may begin to see it, when the Night is already become dark) is like that of the Tail of a Comet, or the Milky Way. But it is yet considerably greater, just in the Line that passes from the Earth thro' the Body of the Sun. Whoever has seen this Vail, that is spread between the Sun and us, will easily grant that it must needs take off some part of its Heat. There has not yet been found, at least as far as I know, any other old Footstep of this strange Phenomenon, but that in 1660, Mr. J. Childrey, in his *Britannia Baconica*, has printed that he had observed it several Years together, and he desired Astronomers to mind it. Thus much seems very possible, that it might be many Years unobserved in the Sky, and perhaps have continued for some Ages, without being minded. But the very change in our Seasons seems now to be a Proof, that it has either not been

been at all, in former times, unless we should find in History such another Series of cold Summers, or at least that it is has not been so thick, or has not lasted so long, as at present. The true System of the World having at length been discovered, by the immortal Mr. *Newton*, we may perhaps guess more exactly, than heretofore, at the natural Causes of this Appearance. ' It seems ' then, at least, the outside of it, to arise from ' some Fumes, or Exhalations, which the Sun ' throws up, with an equal Strength, and the ' greatest it can, all about its Body, perpendicu- ' larly to the several points of its Surface. And ' the Sun revolving at the same time, about its ' Axis, in some 25 Days, occasions the spread- ' ing of that Smoak, near the Plane of the Sun's ' Equator, much farther than it dos towards the ' Poles. The Parts of Smoak, whose Swiftnes is not so great, do not rise so high; and per- ' form all their Motions, within the Body of the ' Phenomenon; not being able ever to come ' near its Extremity. And, supposing several ' Degrees of Swiftnes in those Particles, the Phe- ' nomenon ought to grow much denser, as one ' approaches the Sun: which our Observations ' also do confirm.

' From the Supposition that the Particles of ' Smoak, that fly out at the Sun's Equator, per- ' pendicularly to its Surface, are able to rise so ' far

*The Ori-
gine of that
Smoak.*

*How to de-
termine the
Figure of the
Space it lies
in.*

' far, as to reach, as by Observation they are
 ' seen to do, the Circumference of a Circle, that
 ' seems, at its Extremity, to be removed from
 ' the Sun by about 70 Degrees, I have calcula-
 ' ted how high would rise the Particles that should,
 ' with the same perpendicular Velocity, fly out
 ' of the Poles of the Sun. And the Calculation
 ' gave me that Height, as agreed very well with
 ' the Breadth, the Phenomenon seems to have
 ' in all its Parts. It would have been easie, up-
 ' on the same Grounds, to make the like Cal-
 ' culations, for so many points in the Section
 ' thro' the Axis, as would have made it sufficiently
 ' known; and by consequence have served to
 ' establish, or overthrow my Conjectures. But
 ' as yet I have neglected to do it. And this is
 ' no proper place to handle this Subject more
 ' exactly.

' I shall only say that I look upon each Parti-
 ' cle of Smoak, that rises from the Sun, as ha-
 ' ving its Motion as free, as if it was a Planet :
 ' The same being observed also in the Smoak,
 ' that composes the Tayl of Comets. So then
 ' each of our Particles revolves in an Ellipsis,
 ' till being near the end of its Revolution it falls
 ' into the Sun again. The whole Body of the
 ' Phenomenon is thus perpetually supplied a-
 ' fresh, somewhat in the nature of those *Jets d'Eau*,
 ' or Water Spouts, they call in French, *des Gerbes*.
 ' The

‘ The extraordinary ~~small~~ number of Spots, that
 ‘ appear for these many Years so seldom in the
 ‘ Sun, whereas in the first half of this Age they
 ‘ were so very numerous and so frequent, leads
 ‘ us to suspect that the matter of those Spots has,
 ‘ for several Years, been kept evaporated and dis-
 ‘ persed, in all the Space I have just now descri-
 ‘ bed.

‘ For ought we know yet this Phenomenon
 ‘ may, at sometimes, by the supervention of a
 ‘ thicker and heavier Smoak, grow denser about
 ‘ the Sun, than at other times; tho’ the outside
 ‘ of it spreads but to the same place, and seems
 ‘ not to increase in thickness. So that our Heat,
 ‘ in our Summers, may very much alter, with-
 ‘ out our being able to perceive any Change, in
 ‘ the outermost Part of the Phenomenon; which
 ‘ is the only Part visible to us; unless the Sun
 ‘ should be totally Eclipsed; and give us, in the
 ‘ middle of the Day, an Image of a dark
 ‘ Night.

*It may grow
 thicker, and
 yet not be per-
 ceived to
 have chang-
 ed, except
 perhaps by
 its Effects.*

Some

Some Directions relating to Fruit Walls.

*Directions
about Garden
Walls ought
to be taken
from Mon-
sieur La
Quintinye,
and the pre-
sent Dis-
course.*

LET the Rules and Directions given by Monsieur La Quintinye be supposed here, as the main Foundation of our Hopes, in raising Fruit Trees. To which Rules must be joyned those, that may be gathered, from the present Discourse. And to the whole the following Maxims may be yet added ; some of them being only an Abridgment of what I have already treated of more at large, and some others being yet untouched.

*Let your
Walls be
straight.*

Let all your Walls be plain, and straight on both sides.

*How they
must be if
they stand by
themselves,
without any
Earth on ei-
ther side.*

If they are to stand by themselves, without any Earth or Terrasse on either side, let them be thicker at bottom than at top, where they must end as it were into an Edge.

Fig. XIX.

That Edge, which is at the Top of the Wall, should stand over the Middle of its Thickness at Bottom, if you would have the Wall to be most solid and lasting. But, if you intend to favour the Trees of one side, more than those of the other side, where perhaps it is not in your power to have any Trees, the Top of the Wall may be removed, going from that side, you intend to favour, towards the other ; provided it dos yet bear directly over some part of the Bottom.

And

And this will make that side the steeper, which probably you design for the outside of your Garden.

The broader your Wall is at Bottom the better it is for Vegetation ; but the charge is also greater. 21 or 3 Foot may be a competent Thickness. The Height will be well from 8 to 10 or 11 Foot. A higher Wall would be more chargeable, and, unless the Breadth at bottom be also increased, it would be less hot, and would not last so long.

Walls of darkeſt Colours are beſt.

If your Wall is to reſt againſt a Terrasſe, or Earth, having a Slope faced with Bricks on the other ſide, it will be well that the Plane, which parts the Earth and the Wall, be perpendicular to the Horizon ; which will make the other ſide of the Wall ſo much the more Sloping. And let the ſeveral Beds of Bricks, which make up your Wall, be, not Horizontal, but a little leaning towards the Terrasſe. So the Wall will be able to withſtand better the Preſſion of the Earth.

*How if they
reſt againſt
a Terrasſe
or Slope of
Earth.
Fig. XX.*

Let the Earth of all your Terrasſes, or other Sloping Grounds, which you intend to face, be thoroughly ſetled, or well beaten, before you face them. Leſt that Earth, by coming to ſink, ſhould ſpoil the Regularity of your Wall.

*Let the
Earth of the
Terrasſes be
thoroughly
ſetled.*

The

The perpendicular height of Sloping Walls.

The perpendicular Height of such a Wall as this needs not be more than 8 Foot.

If you would have a Terrasse, with solid Walls on both sides, they must be built after the same way.

Their Inclination.

Let the Inclinations of all your Terrasses be made, according to the Directions, I have given at large, in the present Discourse.

If your Terrasse be very Sloping on both sides, let it have some little Thickness at top; that the Earth coming more and more to settle, the two Walls, that face it, may not come to touch one another.

Of a broad Terrasse and how it may be made;

Fig. XXI.

Fig. XXII.

When its sides are almost equally leaning;

Fig. XXIII.

Fig. XXIV.

Terrasses that are flat at top, with a Walk there, are very Noble and neat. But if this Walk be broad, you may consider whether you had rather build two Walls breast high, on both sides of the Terrasse, so that the facing of it be not altered by them. This will save the charge of bringing so much Earth, and is capable of the Ornaments of Architecture, or else may be performed after a very plain way, and with little charge. It is most proper for such Terrasses, as have both their sides almost equally leaning. Such are those that run from North to South, or from North West to South East.

You might also have a Wall breast high, only of one side of the Terrasse; which would spare some charge, and be pleasanter in walking.

This

This is very proper, when your Terrasse runs from East to West: for thus your South Wall, having at the Top of it the Wall breast high, your North Wall will have a more proportionable Height for Trees. See the Figures quoted in the Margin.

The Ground of your Alleys may be made Sloping by some 5 or 10 Degrees &c, towards the South: which will expose it better to the Sun; and cause the Water to run more towards the North Wall, or worst side; and make the Ground near the South Wall to be the dryer. This will be particularly proper for Vines, which thrive best in a pretty dry Ground; and for a Country subject to much Rain.

Your North Wall might be left bare, without any Trees; which would make the reflected Heat to be much the stronger, upon the South Wall. And then, at the Foot of the North Wall, might be sown some Plants that require, in your Climate, in the Spring and Summer, much Sun Shine, and a Ground not very dry. Such might be some Strawberries, or any other smaller Plants, that are common in Gardens. So then one side of your Alleys may be for Fruit, and the other side for all sorts of Herbs. But, if you think fit, the Earth of the North side may wholly rest, and be kept in store, to renew the Earth of the South side, as there shall be occasion.

And when the Terrasse runs from East to West.

The Ground of Alleys for Fruit may be made Sloping towards the South.

The North Wall may be left bare, and Herbs sown at the foot of it:

Or else the Earth be kept resting, in order to renew that of the South Wall.

R

You

Slopes preferred to Walls.

You may order, after the manner I have said, whatever Walls, or Terrasses, you build; preferring always a Terrasse, with a Slope on each side, faced with Bricks, to an Earth, or Slope, walled on one side, and only faced on the other: as this must be preferred to a simple Wall, without any Earth.

If you can have but one Slope, give it the best Exposition.

I need not say that, if in your Garden you will have but one Slope, it should be against the best Wall, and reach the very Top.

Of a Slope round the Garden.

A Garden may very properly be surrounded by a Slope of Earth, walled on one side, and faced on the other; the Wall being at the outside of the Garden. But, if you please, you may not make the Slope, that would look to the North.

Of a Terrasse round the Garden.

If you will be at a greater Expence, you may have a flat Terrasse round your Garden. Or else, before your Slope, that looks to the South, build a sharp Terrasse, having the whole length of your Garden. The same you might do along your Slope, that looks to the North. And so you might have as many Terrasses, as you please. But it is best not to part them, by a Garden between, but to keep them all together; because they will be thus better sheltered against Winds.

Of Flat and Sharp Terrasses.

A flat Terrasse is that, which has a convenient Walk at the Top of it; whether it be walled or only faced on both sides. A sharp Terrasse is, for the most part, only faced on both sides,
an

and ends at Top, as it were into an Edge ; there not being Room enough for a Walk. It may also be walled on one side, and only faced on the other. The same may be said of a Flat Terrasse.

A Sharp Terrasse is preferable to a Flat Terrasse for Cheapness. A Flat Terrasse is preferable to a Sharp Terrasse for State, and for the convenience of the Walk it affords.

If your Climate be subject to very dangerous Winds ; from which your Walls must be secured at any rate ; the best will be to make, in a convenient place, two Terrasses, running exactly from East to West, like those of the second and third Figure. I have no new Directions to give, about the Insides of those Terrasses. They must be faced with Bricks ; and, the Side exposed to the South being used for Fruit, the North Side may either wholly rest, or be employed as you think fit. But, as to the Outsides, these not being designed for any use, you may make them as steep as you please. Then you may fill the whole Spaces, comprehended by the indefinite Lines, or rather Planes, AM, AO, EN, EP , continued as far as you think fit, with Trees, and very tall and thick Hedges &c ; or with Buildings, and whatever else is able to stop the Wind. Both the Ends of the Alley must be stopped, by a cross Terrasse each ; and, at their outside, the

*Description
of a Walk
very well se-
cured from
Winds.*

Fig. II. III.

same care must be taken for a Shelter, of very tall Hedges and Trees, against Winds.

Thus the Walk, between your Terrasses, will be sheltered, as much as possible, and the Heat in it will be very close, and the Sun Shine, that is lost, will be inconsiderable.

I do not mean only that such Buildings and Plantations, as I spoke of, may be made about your Walk, to secure it from Winds : but that you may also take your advantage of Buildings already made, and of Trees already planted, even of those of a Forest, to make your Alley between them, and to secure it, by the Shelter they will afford.

Of the Disposition the Roots ought to have, in a Tree that is to be planted against a Sloping Wall.

The Roots of the Trees, we are to plant against our Sloping Walls, should not be disposed after the same way, as if the Walls were perpendicular. If there be but one Root, it is best placed, when it makes an Angle, with the Body of the Tree, equal to the Angle of the Sloping Wall, with the Cultivated Ground. And then such a Root, being turned from the Wall, will be Horizontal. But, tho' the Root made a smaller Angle with the Tree, yet there will be commonly some position, where it will naturally place it self, in your Cultivated Ground, in an Horizontal Situation. But this must be done with judgment, so that the Roots, of different Trees, may not too much intermix.

If

If there be but two Roots in your Tree, when they are opposite, and both Horizontal, place them parallel to your Sloping Wall. If they be not directly opposite, they will be best, when they both bend a little downwards, from the Body of the Tree. And you will easily find what Situation is best, for the Tree, with keeping its Body parallel to the Situation it is to have, and, at the same time, turning the Tree about its own Axis. After the same way, whatever be the number of your Roots, and their Situation, you will know how to place the Tree, if you endeavour to find how all the Roots, without running too deep, from the places, which are heated by the Sun, can best remain under Ground : especially under the Cultivated Ground, which receives more the benefit of the Dew and Rain and Sun Shine, than that which is under the Wall. And, when the Roots are long and pliant, you may place them, at your pleasure, in a Situation parallel to the Surface of the Ground, or to the Plane of the Wall ; according as they are near the one or the other of those.

The Fruits that grow pretty high, from your Cultivated Ground, will require that you should have, in order to gather them, a Ladder somewhat particular, with two Arms at the upper End, by which it may be kept from the Wall, and from the Trees. And such a Ladder, being

*Description
of a Ladder
to be used a-
bout Sloping
Walls.*

once

once fixed, will be near parallel to the Wall ; and will serve to gather at once all the ripe Fruits in that place ; or to do all the necessary Work about the Trees, be the Wall never so high ; till you remove the Ladder, to another part of the Wall.

*Of Harbours
and Summer
Houses, in
our large
Gardens.*

Some Harbours, Cabinets, or Summer Houses, in our large Garden, might be very well placed at the four Corners. They should have the full Breadth of the Alleys, or rather more ; so that they may face the middle of them directly. And the Walks may be continued into one another, by cutting a round Space, from the Corner of the Canal. I have drawn, in one of the Corners of the sixteenth Figure, some pointed Lines, which shew how I mean those Summer Houses should be made ; and what changes they will give, both in the Alleys and Canal, and in the Corners of our main Terrasse.

Fig. XVI.

Smaller Harbours, or Grottos, may be made under the Terrasses ; and may serve for shelter against Storms, and for Store-Houses for our Fruits : not to keep them there for a good while ; but to lay them up, till they be carried to a more convenient Place. They may be of about ten Foot Square ; and have their Floor lower than the Ground : and cause no other change, in the outer Part of the Terrasses, but that a Way must be cut to them, along that Corner of the Walk,

Walk, which is exposed to the North West. They must have a good deal of Air from the Door &c. And, according as you would have them dry, you may have, under your Trees, in the South Wall, a small Window, of a convenient bigness, so much raising from the Wall, as to exclude the Rain. And, if you fear lest your Harbour, or Store-House, might prove too damp, you may make it narrower, and spread it under a greater length of the Terrasse. This will give you the liberty of making the Floor higher, and level with your Alley, or raised above it, by two or three Inches, or more.

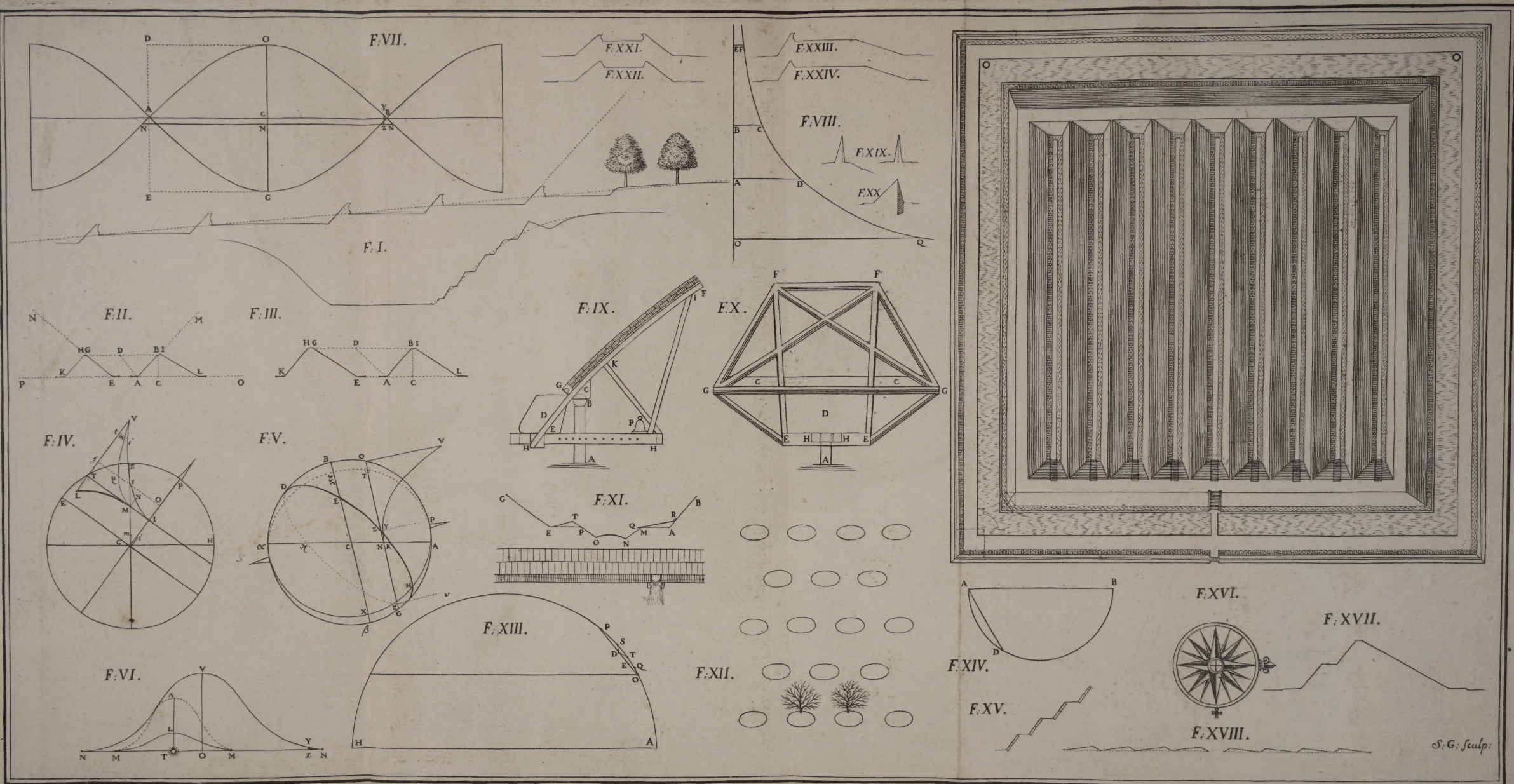
One is not apt to think that a Brick Wall, altogether smooth, and without any jetting out, and Windows, should be capable of some pretty Ornaments of Architecture. Yet I find it may be very much imbellisht, barely by the different Disposition of the Bricks: And I have given an Instance of it, in the Frontispice. There I made use only of Bricks, whose Measures are as follows:

Ordinary Brick;	Length 4.	Parts;	Breadth 2.
Double Brick;	4.		4.
Half Brick square;	2.		2.
Half Brick long;	4.		1.
Quarter Brick;	2.		1.

But.

But one might also imploy Bricks of different Colours and Sizes. What is done in the Frontispiece, for imitating an Architrave, Freeze and Cornish, might also be done for Pilasters, and for large Partitions between them, like the Square Frames of our Wainscot, or like our Windows. I say this, after having tried it, and perceived that even the *Schizzos* I made looked noble and pretty; and imitated our good Architecture, beyond what I could have expected, without having any thing either Gottick or Fanciful. The Example you have, in the Frontispice, is very much inferiour to what might have been done, if there had been more Room. And not only the Modillions, of the finest orders, might be easily imitated; but so might also the Triglyphes, and Metopes, of the Dorick.





S. G. sculp.

